Electrical Engineering

February
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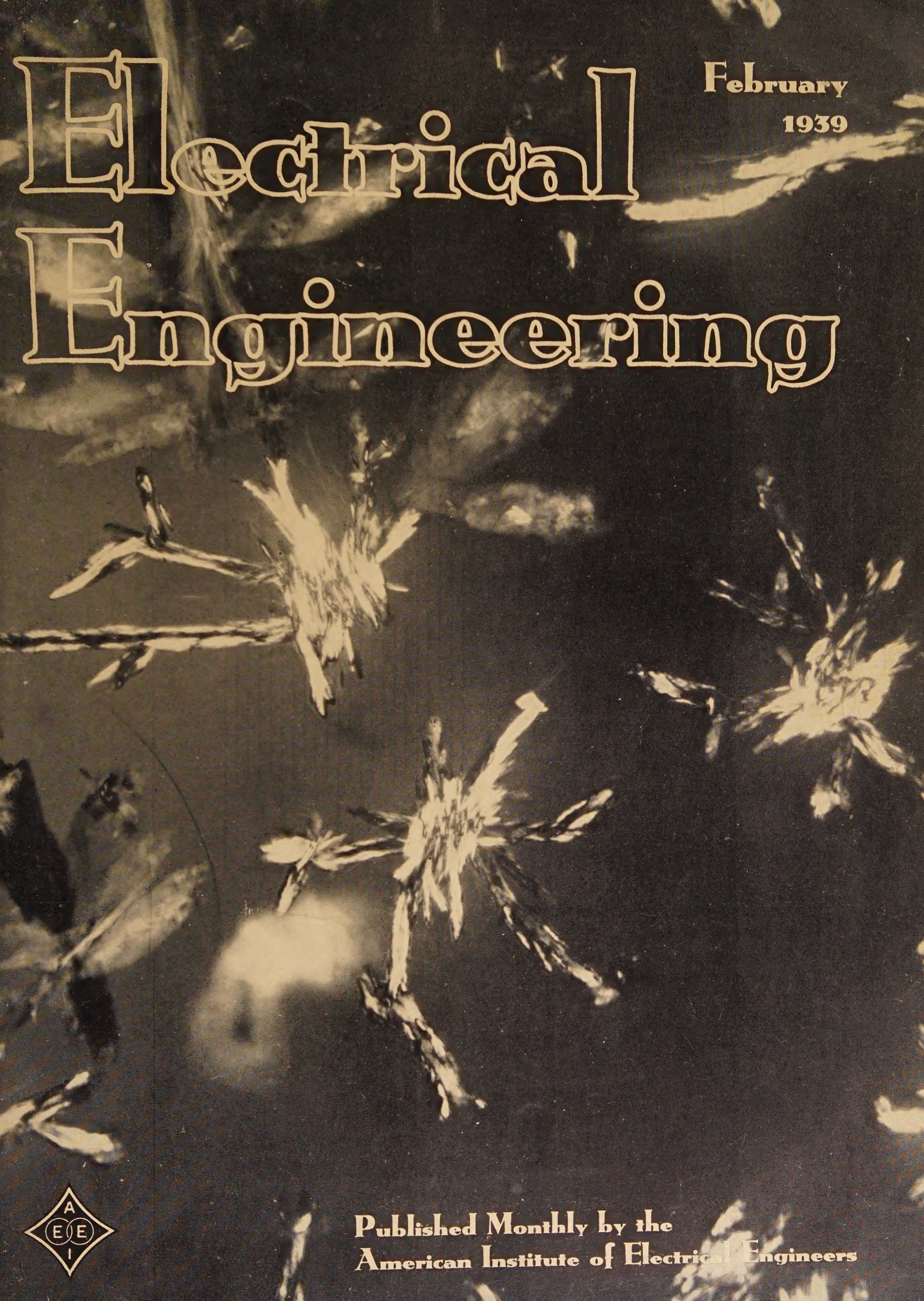

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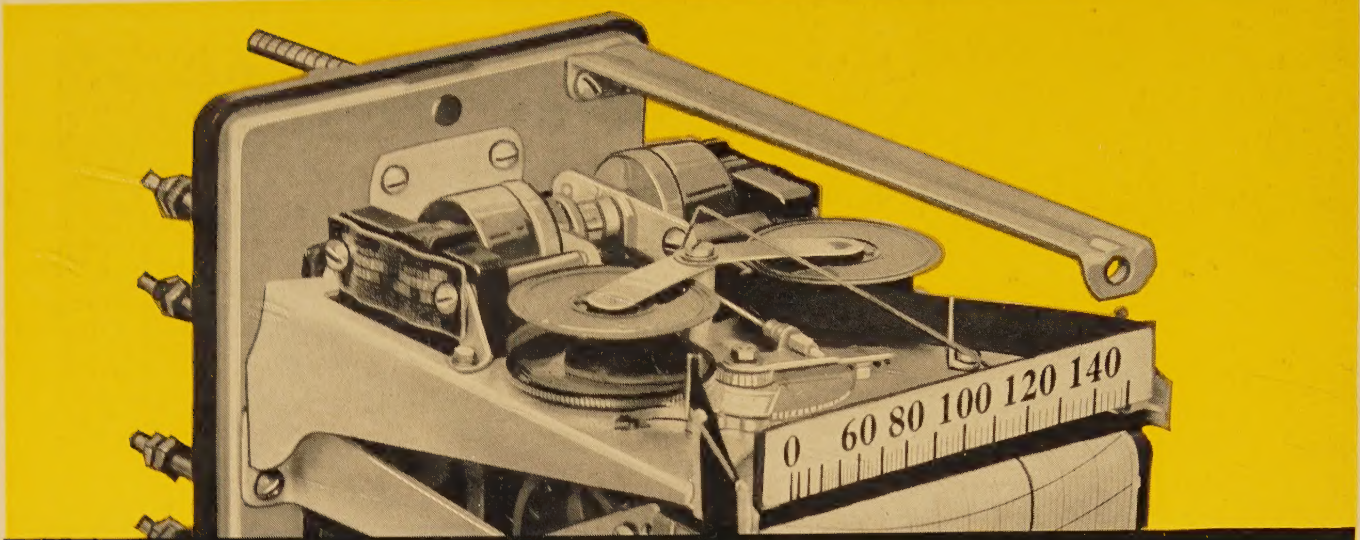

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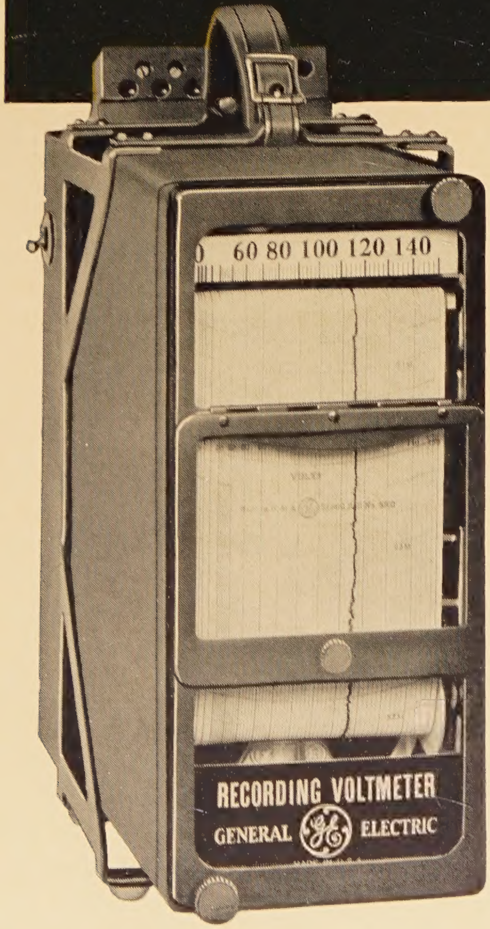

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The Cover: Electrical insulation continues its advance through fundamental research. This month's cover shows a microscopic view in polarized light of a mixture composed of ceryl alcohol and liquid paraffin; as this mixture was cooled, the power factor increased markedly at temperatures near which the butterfly-like patterns began to form.

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¶ **Correspondence is invited on all controversial matters.**

High Lights

Mathematics, Physics, and Electrical Engineering. Early departments of electrical engineering were outgrowths of physics departments in American universities; the two again are becoming more closely allied as research in fundamental physical phenomena develops advances in engineering (*Transactions pages 35–6*). Co-ordination between mathematics, physics, and electrical-engineering subjects must exist to some degree in every electrical-engineering curriculum; it may be achieved in part through informal and voluntary discussions between instructors. Representative committees may guide such revisions as are made necessary by new advances (*Transactions pages 36–7*). Educators disagree on the real causes of the lack of co-ordination of instruction in mathematics, physics, and electrical engineering; an examination of some of those more commonly advanced leads to a proposed evolutionary process which might improve the present faculties in large universities (*Transactions pages 38–40*). Facility in the use of mathematics and physics in the solution of engineering problems is developed in a plan of study in which typical problems of practical value are assigned. Problems are selected from those described in technical publications; references to the published papers are given after the students have completed their solutions (*Transactions pages 40–1*). A broad philosophy and viewpoint with respect to science that are difficult to develop in engineering courses may be developed by proper teaching of the co-ordinated work (*Transactions pages 42–3*).

Polarity Limits of the Sphere Gap. Extensive use of sphere gaps in high-voltage tests and research necessitates complete data on their characteristics and limitations. It is reported that 60-cycle polarity characteristics of grounded sphere gaps correlate sufficiently well with the positive and negative impulse calibration curves to permit the use of the former for determining the polarity limits for sphere gaps (*Transactions pages 56–9*).

Management and Society. "Management must stand by its colors, struggling to maintain the cause of free enterprise in a world threatened with too much regimentation," said the chairman of the board of a leading electrical manufacturing company who added that "free enterprise may confidently hold up its head as representative of one of the most vital functions in our national economy today" (*pages 81–5*).

Self-Excitation of Induction Motors. It has been known for some time that an induction motor may supply power as a generator when provided with excitation from capacitors. The increasing use of capacitors for power-factor correction has increased the importance of predetermining the characteristics of an induction machine when operating under these conditions (*Transactions pages 47–51*).

International Units. New absolute units for electrical quantities will be placed in effect in 1940 as another step in the development of international standards. The change will be insignificant from the standpoint of ordinary electrotechnics but will need to be taken into account in electrophysics (*pages 78–80*).

Opportunities in Manufacturing. Electrical manufacturing is one of the industries in which engineers are a relatively large percentage of the employees. Some 1,600 companies of various sizes in the United States offer opportunities in research, development, design, application, and sales (*pages 72–7*).

Automatic Telephone Devices. A voltage range of about 70 decibels (over 3,000 to 1) must be considered for telephonic message circuits. In order to accommodate such ranges of intensity to certain transmission media, such as radio links, a new family of automatic devices has been developed (*Transactions pages 62–7*).

Lightning Arresters. To meet a need for information dealing with the testing and application of lightning arresters, the lightning subcommittee of the AIEE committee on protective devices has prepared a report outlining current practices covering line-type arresters rated at 15 kv or less (*Transactions pages 68–71*).

Edison Medalist. Accomplishments of the recipient of the 1938 Edison Medal in engineering and in education are revealed by one of his former students in an address delivered during the 1939 AIEE winter convention (*pages 64–6*).

Incentive and Security. For continued achievement in civilization, proper balance must be maintained between incentive for further progress and security of social position. Without incentive there can be no long-time security (*pages 67–71*).

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Social Significance. Engineering's social significance lies much deeper than the physical manifestations that are evident today. Civilization and community life have developed with engineering progress, and study of the relation of engineering and political economy is now a real need (*pages 59–63*).

Trends in Hydroelectric Plants. Recent trends in the design and arrangement of electrical equipment in hydroelectric generating stations have been in the general direction of greater simplification, reliability, and lower first cost (*Transactions pages 78–82*).

Deceleration Tests. By proper selection of equipment and analysis, deceleration test methods, which in the past have been limited mostly to large machines, may be applied to smaller machines having relatively short stopping periods (*Transactions pages 72–6*).

Variable-Register-Ratio Meter. To investigate the possibility of applying the law of supply and demand to the metering of electric energy, an experimental meter having a register ratio variable in accordance with the system demand has been devised (*Transactions pages 76–8*).

Bismuth-Bridge Fluxmeter. By making suitable alterations, a bismuth-bridge magnetic fluxmeter designed originally for measuring d-c fields can be adapted for the measurement of a-c fields and for transient-flux investigations as well (*Transactions pages 52–5*).

New Trim Size. Effective with the January issue, the trim size of ELECTRICAL ENGINEERING has been changed to $8^{3}/_{4}$ by $11^{5}/_{8}$ inches simultaneously with other technical journals, in order to accommodate advertising plates of a "standard" size interchangeably.

Coming Soon. Among special articles and technical papers undergoing preparation for early publication are: an article discussing the benefits of graduate training for engineers by L. W. W. Morrow (F'25); an article outlining the power requirements for electrochemical, electrometallurgical, and allied industries; a paper by J. M. Gaylord (F'35) on the pumping system of the Colorado River aqueduct; a paper by E. W. Morris (M'35) on applications of copper-oxide rectifiers; a paper by William T. Thomson (A'37) on ferroresonant circuits; a paper by H. H. Skilling (M'34) on the electric strength of air at high pressure; a paper by A. M. Skellett on a narrow-band transmission system for animated line images; a paper by R. E. Pierce (M'31) and B. W. Hamilton on phase-angle control of system interconnections; and a paper by J. A. M. Lyon (A'38) on the electrostatic unbalance of transmission lines and its effect on Petersen coils.

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The Social Significance of Engineering

By DUGALD C. JACKSON
FELLOW AIEE

Civilization grows as a consequence of community contacts among human beings, which contacts are largely made possible by engineering. The relation of engineering to society and social adjustment is one of inseparability, and although much progress has been made through historic time in the improvement of living conditions, further opportunities for improvement are outlined in this article by a noted engineer.

BECAUSE the effects of engineering run all through living conditions, engineering's part in the development of civilization is of great importance to engineers and to engineering education. The subject discussed here is a broad and pervasive one which means the import of engineering to society. It also includes various subtopics by implication. For example, it includes the social influence of engineering, which means the effect through the senses which engineering exerts on society; it includes the social implications of engineering, which means the intimate connections which relate engineering to social organization and social interrelations; and it also includes, among other things, the status or position of engineering as an entity with respect to society organization as an entity. In this discussion I will go somewhat broadly into social relations and deal with the tripartite interrelations of engineering, social organization, and civilization.

It is proper here to comment that true civilization grows as a consequence of community contacts among human beings, and intimate community contacts, broadly speaking, are made possible by and are dependent on the fruits of engineering. Such fruits became vaguely manifest many thousands of years ago and have steadily ripened and increased in scope and variety, through those thousands of years, down to the present time. Further ripening and variety-increases apparently will go on through future ages. I cannot here go into the demonstration of the fundamental and continuous relations existing between social organizations and engineering. Those who may be interested to trace the growth of these influences are referred to a series of six articles on "Engineering's Part in the Development of Civilization" published in *Mechanical Engineering* from July 1938 to December 1938. In those articles I have shown that community life was made possible by engineering; that some degree of civilization (which rests on principles of ethics and codes of morals) is a necessary accompaniment of community life; and, as a consequence, engineering is an inseparable companion of civilization. The increased responsibility for mutual sympathy and mutual welfare laid on individuals and on communities by the doctrines of the Christian religion have increased for engineering its opportunities to serve and its responsibilities.

The mental picture of the outcome of engineering usually held by human beings in the civilized world is of steam engines and what they have done for us; steam railroads; steamships; electric telegraphs; telephones; automobiles and hard-surfaced roads; radio sets and broadcasting stations; great structures like tall buildings, bridges, canals, harbors, and irrigation works; potable water supplies and sewerage; manufacturing plants; manufactured products; and like physical evidences. But these are only emblems, which are at the surface today. These are instrumentalities of engineering which have social significance, but it is inadequate, even superficial, to rest our attention with them.

To understand truly the social significance of engineering and the part that engineering has played in the development of civilization we must go deeper into the problems of society and the molding influences of engineering thereon. It is necessary to begin with the conditions of the earliest village life, which originated in prehistoric times but which have left their records in the development of community life and civilization. We can picture these conditions from artifacts and other remains that have come down to us. It was through village life that civilization began, and through engineering that village life became possible. The single family or small group, living in a more or less roaming and precarious stage, had no civilization; but village life led to community of interests from which sprang the development of ethical principles and codes of morals that are the basis of civilization. It was thus that civilization germinated out of social organization.

Having germinated, it expanded over the world along with the movements of peoples, as sailing and rowing ships and maritime commerce grew up, and as extending trails and roads made some land commerce possible. Man seems to have been a natural trader in commerce after his gregarious period had arrived. The foundation development required a growing state of material and social well-being among men, with which there became associated a sympathetic mutual interest between individuals, and by individuals for the community welfare, in villages. It is the community of interests which arises from integration of groups of people, that develops the qualities which characterize civilization; and conditions for living which make decent village life possible depend on engineering.

Principal part of text of an address delivered at a conference on the social significance of engineering at Lehigh University, Bethlehem, Pa., October 26, 1938.

Dugald C. Jackson is professor emeritus of electrical engineering, Massachusetts Institute of Technology, Cambridge. A biographical sketch of Doctor Jackson may be found in the January 1939 issue, page 50; a review of his accomplishments appears on pages 64–6 of this issue.

Conscience and morals arise out of the social contacts in the family, clan, and community, and civilization germinated in the community. Thus engineering was a frontier influence on civilization and social relations and it has been expanding that influence ever since.

The influences of metallurgy, of other engineering inventions, of agriculture, of domestication of animals, and of written language became of great force among the early peoples; and community concentration became greater. Aided by engineering factors, trade between communities grew up and caused further extension of human contacts which depend for their amity on ethics and morals. Tools and simple weapons are evidences of artisanship as also are crude pottery, weaving, simple agriculture, and some domestication of animals. But the trail of rudimentary structures, foresighted judgment regarding desirable village locations, and planned metallurgy, which trail was already trodden by some communities at the Dawn of History, is the pathway of engineering—that is, it is the trail of the use of intellectual processes to bring together and combine physical elements into a co-ordinated unity (such as a structure or process) for the convenience of man.

Add complex machines to these other engineering features, as is ultimately done in engineering, and we step far along in the possibilities for social relations. At the Dawn of History man had come to the stage when security of life and livelihood could be sought after with some expectation of success. Each step forward in the progress of engineering invention which contributed to the security of life and property for early men gave further impetus to the tendency toward community living and this led to further emphasis also on ethical relations between man and man and tribe and tribe. In this connection the importance of the ethical relations is to be remembered. Power to control men's life and property without restraint gives power to control their subsistence and this is equivalent to power over their will. Out of this condition most of the autocrats and dictators of the world have made their hold secure. Let us beware!

Group Association

Civilization connotes harmonious co-operation of many human beings and also mutually sympathetic, helpful, and elevated relationships. For early men, this civilization (such as there was) went hand-in-hand with the crudely growing engineering arts. This was because the engineering arts enabled groups of people to become closely associated for the purpose of securing their safety of life and ease of living without sacrificing either existing conveniences or major comforts, as far as conveniences and comforts were then available. The group association of people proved the need of rules and customs of the nature of ethics and morals and a practical application of those rules to life. Generation after generation, with hesitations, recessions, and recoveries, somewhere in the world further steps in engineering improvements have been accomplished, with accompanying greater human intimacy and morality. The relations disclosed in our day show that there is still far to go before the goal is reached. Acceleration of the progress is desirable but all records of experience show that incautious haste in reform measures is a fruitful cause of confusion and that it actually tends to delay the pace of progress in its major ways. Let us be cautious!

Each step forward in the progress of invention looking toward security of life and property for early man gave further impetus to the tendency toward community living and this further forced a growing respect for simple mutual interests. However, it was only after the stimulus for making inventions had resulted in an easier life with regard to life security, food, and shelter, and also had released to individuals more time for cultivating physical ease, that growing ethical relations between man and man and tribe and tribe became strongly evident, and community living became smoother. The early aims of each human being seem to have included security (that is, safety for life and limb, sufficiency of food, adequacy of shelter from the elements) for self and family, such as characterizes the objectives of most mammalian animals. Then man gradually came to desire the permanent establishment of health, recreation, and contentment (or perhaps the correct word would be happiness) as part of his "place in the sun."

At the present period of our nation, our people are overdoing the shout for government-supported "security" maintained for individuals without aid of their own contributions accompanied by sweat of the face. Nevertheless, reasonable security of life, livelihood, health, and happiness is the stuff out of which civilization is made. Man has sought and still insistently seeks security of life with its concomitants, and also the greatest degree of convenience and comfort which may be derived from any given expenditure of energy; although, on occasion, he proves willing temporarily to sacrifice all of these.

When reflecting on this, we must remember that, as Sancho Panza says, "Good fare alleviates care." Engineering plays a strong part in meeting fundamental human aspirations. It is a human and intellectual affair. It deals with forces and materials provided by nature, and adapts them to human service for the satisfaction of human aspirations and needs as they are felt in each particular period; and in our period all commerce depends deeply on engineering. Gathering of raw materials, manufacturing, transportation, storage, and even the handling of goods, have become the children of engineering. Even farming (at least in America) has become permeated with the effects of engineering.

Stimulation of Needs

Moreover, as engineering achievements extend, the process of satisfying aspirations and needs stimulates human society (as individuals and as groups) to formulate additional aspirations, picture additional needs, and claim their fulfillment. One's needs seem to increase along with one's opportunities, and failure immediately to satisfy the seeming needs to the full causes disappointment that seems like suffering. To qualify safely under such conditions, engineering must live under the guiding influence of the social philosophy of the successive periods, while always controlled by the restraints which characterize exact science.

This combination is a lively cause of friction. The stimulus of their aspirations and felt needs leads most human beings to press for an immediate fulfillment. This ambition often is encouraged and supported by theorists who have failed to observe that too great rapidity of change in social organization leads to ultimate harm instead of permanent satisfactions. Life in the aggregate is a composite of multifold relations and always has been. Revolutionary changes of social organizations usually leave a train of wreckage and hardship for all, including those most in need of improved conditions. Sound judgment demands that changes be made considerately, gradually, and with careful forethought. Thoughtful consideration is the way of wisdom. The records of history make these relations plain, but time does not permit the exposition of those records here. During the past 150 years our engineering improvements which are competent to afford convenience and comfort for all people have come rapidly forward, but our legislative acumen and foresight have not advanced in equal degree in the same 150 years. Alexander Hamilton wrote in the *Federalist* 150 years ago that: "Necessity, especially in politics, often occasions false hopes, false reasoning, and a system of measures correspondingly erroneous." Hamilton's pregnant cautionary words still carry a significance equal to the significance which they held in his lifetime.

Dangers of Ignorance and Prejudice

As citizens, we of this nation are proud of the education from which we profit. There is considerable justification for the pride, but instances arise which show that the results of education have not fully permeated among the citizenship even for the most elemental affairs of life. I will cite an extraordinary illustration which was disclosed to me as a bona fide occurrence. A married woman from low-income circles appeared almost annually at a hospital for delivery of a child until the family was an even dozen. Again she came, and (as she was leaving this time) the attending physician said, "I presume we will see you again next year." "No, ye'll not," said she, "me husband and me has just learned what makes them." This is quite on a level with the ignorance among some of the primitive aboriginal tribes of Australia and elsewhere, of which the natives "do not recognize sexual intercourse as a cause of conception" and give other specific causes.

If we still have in our midst such ignorance of fundamental biological phenomena which arise out of our personal intimacies, is it reasonable to expect a general sound knowledge of the less concrete phenomena of economics and society? Even our most expert citizens confess shortness in assurance regarding the latter phenomena. Therefore, the acute frictions (such as arise, for example, in the industries as a consequence of the close intimacies brought about so rapidly by the engineering inventions of the last two centuries) are likely to be the unhappy outcome of ignorance and prejudice. Such being the case, they are causes calling for sympathetic, man-to-man adjustment with such mutual forbearance as can be marshalled. The old-time destructive violence guided by violent minds, which was associated with industrial combats of my youth, is now outmoded in the minds of many of our citizens and must be brought to condemnation by all. Education which tends to the diffusion of truth, and thereby eradicates ignorance and prejudice may come to the rescue.

The factual and disclosing information which might enlarge knowledge and allay prejudice in this field is not readily available from books, monographs, and magazine articles. Fuller measures of factual disclosure are needed so that honest and adequate information may be before the public in general. Constantly applied, careful efforts at making facts known throughout the nation, in my opinion, is a shining means for forestalling the effects of ignorance and prejudice and for thereby ameliorating a sore spot in the social relations occurring as a consequence of engineering. An uninformed public usually is influenced by predetermined notions and prejudices; but the American public, when it feels itself rightfully informed and has had time to reflect on its knowledge, usually proves itself to be fair-minded. We are likely to forget that success in impressing the intelligence of great masses of people requires that clear, factual expositions shall be repeated again and again; although demagogic or inaccurate eloquence, once or twice expressed in fluent nonsense trickling from the speaker's tongue, may emotionally carry the same people into great error.

Work a Human Need

The inseparable relation of engineering to civilized society and to effective social adjustment is seldom given enlightened attention, and much of the fault of some ardently preached social doctrines is the result of popular misunderstanding of the true sources for enlarging material wealth. It is an unavoidable reality of nature that increases of permanent wealth are gained fundamentally only from what is grown on the surface of the earth, and taken from within the earth, from the waters of the earth, or from the air surrounding the earth; and that the processes of securing the wealth require muscular and mechanical power directed by the minds of men. For the populations to cease to work would mean that they would cease to live. We must keep industrious with minds and muscles or we cannot live in the comfort and plenty which is an ideal among western nations—evolved to different degrees in different nations but existing in all. It is important also to remember that joy in useful accomplishment, by the individuals composing a society, is essential to the realization of the best social adjustment.

How to incite joy in accomplishment is indeed a problem; but the engineering of machinery to lift long hours of muscular labor more and more from the shoulders of men, associated with spreading mental effort more generally among men, is a promising path to the solution. Moreover, an increase of leisure which is so ardently desired by most people can be accomplished only by substituting in all practicable situations mechanical power for muscular power, by means of inventions which make the substitutions possible at moderate capital expense so that an extra margin of saving is produced, from which all concerned may profit. The phrase "all concerned" includes workers and customers as well as owners. It here is to be noted that scientific discoveries and engineering inventions which lessen the cost of useful processed products or which provide useful new products usually increase the rate of the production of new wealth.

Engineering is a process of planning, organizing, and executing work concerned with directing the forces of nature to the service of mankind; while the word civilization connotes well established, sympathetic ethical and moral relationships in society. The latter relationships develop only where considerable numbers of people work together for common ends, and means of community living or other community contacts are provided by engineering for the grouping of the people in harmonious unity and providing for their material needs. This must not be mistaken for communism. It is quite the contrary. Full civilization connotes harmonious well-being based on mutual sympathy associated with ethical and moral relations in society, while democratic independence of the individual is maintained to the limit of conscience expressed without external restraint. Communism, on the contrary, suppresses individual independence; and it may destroy mutually sympathetic relations while providing for livelihood in common.

The human mind, in mass, is very slow to change in character; and stable improvements of mutual relations cannot be rushed to success by the vaguely applied efforts of professional reformers or dilettantes in social affairs. Such improvements may only be successfully produced slowly, in association with sounder-growing mass thought regarding living affairs in both material and ethical relationships; and here the influence of engineering in showing the ways to material betterment is of primary importance. Following in the wake of material betterment and increased leisure, intellectual improvement also usually comes as an ultimate contribution to social welfare.

By living in ready contact with each other, we have come to recognize (in at least a glimmering degree) that the best living is when life is put to intelligent use in mutual advantage. We yet have much to learn before this is realized at a reasonable level, but ultimately we will be able to mold our engineering so as to achieve the wished-for ends. Sound progress connotes aid in bringing forward those persons who need aid and are willing to co-operate in the effort at aid. It also connotes unrestrained encouragement of the practices of those who are competently proceeding with ethical consideration along their individually chosen creative courses. This combination of connotations needs to be constantly emphasized.

Improvement in Living Conditions

One who studies with concentration the changes which have occurred in the living conditions of the populations of European nations during the last 200 years, or of our people during the existence of our own nation, must be impressed by the great change for the great proportion of the people from sordidness and insecurity of life and *livelihood* to relative security, comfort, and happiness. In these days, certain of our fellow citizens point to Sweden as a notable example of economic and social welfare. In a relative way, they are right; for Sweden has come forward in an admirable manner out of an age of sordid living and misery for most of its people. Means for ready and economical transportation, means for quick transmission of intelligence, means for generating and transmitting power, means for sanitation, and other great engineering achievements have changed the face of the people. The sordid and miserable have been raised and the disparities in security and happiness which formerly existed between the few and the many have been notably lessened by improving the lot of those formerly miserable.

The same miracle has occurred to the people of the British Isles, France, and other nations. The changes have beeen gradual but effectual, and they continue their course. The sound results have come from utilizing cautiously-applied measures for lifting the many. Where tearing down the superior economic and security status of the few has been practiced, it has always left in its train a legacy of disadvantages and misfortunes that affected people in all conditions of living.

Our experiences have not been without analogy to the experiences of European peoples and we may well examine the signboards of their history. We started later, with a pioneering people whose active utilization of their restless intelligence in a favorable setting did much for them. Our utilization of engineering achievements has been correspondingly active, and engineering invention has gone on at a high pace. The living conditions for our healthy and industrious citizens have been at a high level compared with the corresponding citizens of Europe. If one-third of our citizens are inadequately provided with food, clothing, and shelter (as viewed from our accepted standard of living) as has been alleged, I presume with truth, they are among those who need betterment and should be shown practical means by which they can come to betterment. But the precedents show that no general gain is secured by pulling down some with the object of raising others, nor by overfast efforts at general reforms such as have been pressed upon us during the past several years. Our social changes, if they are to be truly serviceable, must proceed at the pace which characterizes natural improvement of thought in an environment of encouragement and they must not be unethical, or our results in the end are likely to be adverse for those who should be helped instead of affording the betterment which is desired.

Politics in this country are seldom free from false slogans of which the unsoundness would be exposed by exacting analysis. We now are suffering from the effects of various partially or wholly false slogans that relate to the fields of government, engineering, education, and security, which have been formulated to satisfy the supposed slogan hunger of the majority of mankind. For illustration, the false doctrine that civilization is decaying has been asserted again and again during the period from several thousand years ago to the present time and people still volunteer their ideas for saving civilization. The answer is plainly spread before us. If decay had in fact been going on over this long period, there would be mighty little civilization left with us today—instead of which we have in the best parts of the western world a civilization which is superior, in the sense of being more comprehensively helpful to man, than that existing anywhere in any of the preceding centuries. This statement rings true when it is tested by comparison of today's conditions of the great mass of people with earlier conditions, whether two generations, two centuries, or 2,000 years back.

If moral relations and security of life mean anything in happiness, as most of us believe, there is more happiness in this country today than heretofore in any country of great population. There certainly are more comforts in life than in any earlier time, and more leisure for most people, mostly brought about by engineering applications of science. And even from this level, progress continues in a clear pace. Trying to overaccelerate that pace by poorly conceived political nostrums harms instead of helps. Efforts put forth to save civilization are only folly and are not needed. What are needed are efforts to deepen and enrich the spirit of sympathetic understanding between men, so as to better the conditions for negotiating the amelioration of those differences which may injuriously arise because of our more constant and intimate mutual contacts.

Influence of Engineering for Peace

Engineering processes and engineering devices have been (and are being) abused by use in warfare, but not by choice of the leading minds of the engineering profession. The profession, with few exceptions, stands on the conviction that war is tragic, expensive, inefficient, and unnecessary. However, as world affairs display themselves, we must be prepared in an organized way as a nation to stand against aggression from without in case aggression should arise in spite of friendly negotiations planned to prevent forcible action. Convince man that war will not ultimately result in greater wealth, security, and stability for him and his nation and the tendency toward organized war will be weakened. Especially will this be achieved if other sufficient routes are kept open on which men's love of risk and adventure can be fully expended, while the paths to selfish profit during war are closed. It lies with us to hold so steadfastly to the duty of more fully developing the peaceful occupations of agriculture, industry, and commerce that the minds of our people may be turned away from contemplating aggressive expansion and warfare. Engineering favorably influences all of those peaceful occupations, and we engineers have an obligation to ourselves and our fellow citizens to encourage the highest practicable development of these ethical aspects of engineering.

That is the attitude of engineering in this aspect of its social relations. The defects in human relations which arise in local, national, and international affairs are due neither to faults in the fundamental ideal of a complete civilization, nor to engineering which has set up and continues to maintain the stage for a possible realization of that ideal. A grave responsibility rests on critics of our status, who are failing in the call for agitation and education of the public to a realization of the relative fitness of things. This is a personal and group matter to achieve, and it cannot be achieved by partisanship or foul play.

Much has been accomplished in the long-time development of civilization. Much is yet to be accomplished. The accomplishment cannot be secured in any nation by legislation alone. The solution can be obtained by joint use of two paths.

One of these leads to continued emphasis on sympathetic negotiations between man and man, or group and group, before going to extremes. Much progress for our country has been made in this path during the past half century. Such progress has been notable in our engineering industries, but it is yet insufficient, and more sympathetic relations must be fostered. However perfect a coin may appear on one face, if it is suffering from corrosion on the other face it is defective and needs reminting. Social reminting in an engineering world with its democratic qualities, however, requires a depth of consideration and range of cautious adjustments which immeasurably transcend the requirements for the machine-reminting of coins.

The other path leads to the joint problem of education in engineering and political economy which now is crying for solution in order that the social problems may be smoothed and society aided to make progress in the best sense.

Our national needs are, on the one side, a moratorium on loosely drawn legislation, careful simplification of laws which we have, and, primarily, emphasized efforts to make ethical principles a guide in both the observation and the administration of statute law. Abstract justice is an ideal, but enforcement of law according to ethical principles can be made a very practical thing.

On the other side, our national needs include a careful nurturing of the results of scientific research and discovery in the fields of natural science and of so-called social science, which may stimulate engineering invention and engineering practice out of which still further improved living conditions may arise. Many endowments for research in natural science and in economics and sociology exist, and our need is for an endowment to promote the study (including research and exposition) of the joint relations of engineering and political economy, having for its purpose the establishment of an understanding of the most helpful relations which may be built up for a prosperous social welfare. This is a need indeed, and a donor can make the nation his never-ending debtor by establishing an endowment to this end.

Dugald Caleb Jackson—1938 Edison Medalist

By J. W. BARKER
FELLOW AIEE

A summary of the accomplishments of the current recipient of the Institute's highest honor reveals a balance between work as a consultant and as an educator

THE life and achievements of the 1938 AIEE Edison Medalist illustrate the nearly perfect interweaving of two great fields of activity, the work of the consulting engineer and that of the engineering educator. Even at the risk of his own health by burning the candle at both ends, Doctor Jackson has made glorious contributions to both fields and has maintained an even balance of the scales. He has demonstrated the desirable cross-fertilization which is possible only when the two careers develop side by side.

Born at Kennett Square, Pa., on February 13, 1865, he was graduated in 1885 as the "class baby" with the degree in civil engineering from Pennsylvania State College where his father, Josiah Jackson, was the professor of mathematics. After completing two years of graduate study in electrical engineering at Cornell University, he and two college friends, J. G. White (later the founder of the far-flung J. G. White interests) and Harris J. Ryan (later head of the electrical-engineering department at Leland Stanford University and director of the Harris J. Ryan High-Voltage Laboratory) founded the Western Engineering Company at Lincoln, Nebr. His pioneer experiences in this company, constructing early electric railways, building electric power plants, and other practical engineering work, together with his close association with two other brilliant minds of diverse types, did much to develop the broad engineering judgment which has characterized him throughout his life.

In 1889 he became assistant chief engineer of the Sprague Electric Railway and Motor Company, installing some of the earliest electric railways in the United States. Then he was appointed chief engineer of the central district of the Edison General Electric Company, but in 1891 he was called to the University of Wisconsin to become professor of electrical engineering and organize the department. In 1907 he went to head the department of electrical engineering at the Massachusetts Institute of Technology, where he remained until his retirement in 1935.

His engineering accomplishments are so numerous and significant that they alone would mark any great man's career. Shortly after he went to Wisconsin in 1891 he organized with his brother the consulting firm, D. C. and Wm. B. Jackson. This firm continued until 1918 when the services of the partners (a third partner had been added in 1916) in the World War caused it to be discontinued. During this period the work of the firm was largely with electric light and power companies, particularly in rate matters, questions of organization, design of generating and distributing plant, and various problems of operation and development. A considerable amount of work was also done for the public utility commissions concerning supervision and control of electric light, power, and telephone companies. One of the most interesting tasks and one of which Jackson was most proud, was an engagement by the British Government Post Office Department to guide them in taking over the property of the National Telephone Company in 1911. Jackson had been chosen for this by a special royal commission which had visited the United States the preceding year.

Service During the World War

During the World War, Doctor Jackson was major and then lieutenant colonel of engineers, charged as chief of the technical board with the procurement of the power supplies for all American war activities in France outside the actual fighting zone. Decorated with the Legion of Honor for this work, he was retained after the Armistice as chief engineer of a special board of the peace conference to evaluate the war damage to physical property in all the Allied countries. Under General McKinstry, this board had eventually upward of a thousand specialists. It is worth telling of his appointment as chief engineer as illustrative of *why* preferment as an engineer and as an educator so often came to him. When he reported to General McKinstry he found a group of some ten other officers, many senior to him, already there waiting for something to start. General McKinstry called them all together and requested that they work singly or in pairs to prepare plans for carrying through this immense project. Many of the other plans were rather perfunctory, indefinite, and meant little or nothing. Jackson's report was complete, giving outlines of classifications under which the properties were to be grouped for appraisal, methods for handling the appraisal of each group, approximate methods to be used when accurate data had been destroyed by the war, personnel required, transportation needs, some idea of the time necessary,

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Prepared especially for ELECTRICAL ENGINEERING.

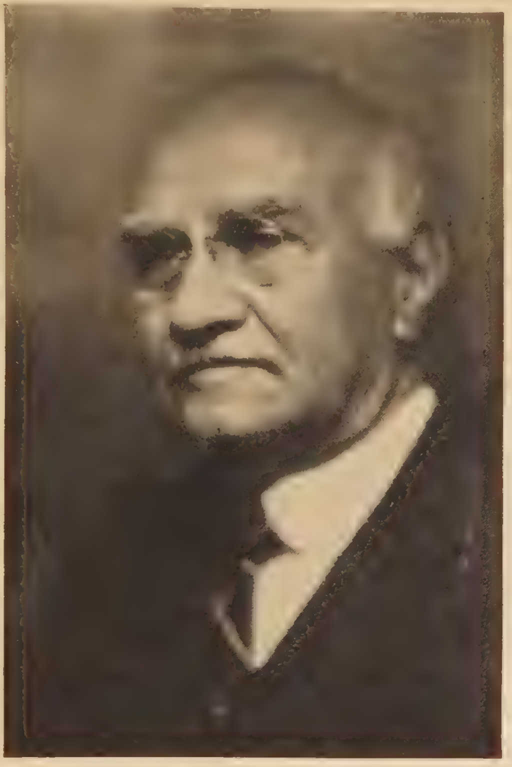
J. W. BARKER is dean of engineering at Columbia University, New York, N. Y. He was born at Lawrence, Mass., June 17, 1891, and received his education at the University of Chicago and Massachusetts Institute of Technology. From 1916 to 1925 he served in the coast artillery corps of the United States Army, attaining the rank of major, and from 1925 to 1929 was associate professor of electrical engineering at Massachusetts Institute of Technology. During 1929–30 he was professor of electrical engineering and head of the department at Lehigh University; since 1930 he has held his present position at Columbia University. Dean Barker is a member of several technical organizations, and has devoted much time to work on AIEE committees.

and an estimate of the cost. Two days later he was appointed chief engineer and some of his seniors in rank wondered why! We who worked with him know why! Possessed of one of the most remarkable memories for all kinds of facts, with an uncanny ability to sort essentials from nonessentials, with a keen analytical ability to get to the heart of a problem, with great powers of concentration and the ability and willingness to work indefatigably, he could and did synthesize such clear, persuasive statements of even a most complex problem like the war damages that his reasoning was followed and his conclusions accepted. This truly formidable array of characteristics marked the man in all his work. There was a common saying in his various offices that after an hour with a report Doctor Jackson would know what there was in the report better than the man who wrote it.

Return to Engineering

Following his return to the United States in 1919, Jackson resumed his professorship at MIT and reorganized the consulting firm with Edward L. Moreland, a former student and partner in the old firm, as partner. Many important engineering projects were handled by Jackson and Moreland, such as Conowingo (favorably reported upon and later built by others), Passamaquoddy (adversely reported upon—and not *yet* built), the 75-mile main-line single-phase a-c Great Northern electrification through the Cascades using a-c d-c locomotives, the Delaware, Lackawanna and Western d-c suburban electrification out of Hoboken, N. J. (both of which were planned and built under the supervision of Jackson and Moreland), and other consulting projects on generation and distribution too numerous to mention in detail—engineering accomplishments of which any man might be justly proud and which would merit the Edison Medal award.

Running all through these activities I have mentioned have been also outstanding contributions to our professional and educational societies—member and past president of many, he looked upon two such offices as opportunities for real contributions. President of our own American Institute of Electrical Engineers in 1910–11 and member of the board of investigation and co-ordination of the Society for the Promotion of Engineering Education, these offices gave him an opportunity to impress his personality and his philosophy upon the engineering and educational worlds.


Doctor Jackson

Jackson's career has been equally distinguished in both phases. Of the two, however, I believe that Professor Jackson has found deeper and more abiding satisfactions through the educational phase, although greater monetary return and somewhat more prestige through the consulting. He has always maintained the desirability of such a double career for engineering educators, since the practical experiences gained in consulting contribute greatly to the enrichment of the teaching. At the same time he has always recognized that proper engineering research for the educator has the same enriching effect on the teaching (and Jackson has conducted much personal research. He has been "starred" in American Men of Science for many years).

Educational Philosophies

Professor Jackson early adopted three basic educational philosophies which have been marked by outstanding results. The first of these was that students should be brought as soon as possible into contact with the unknown, thus stimulating them to think for themselves, instead of drilling into their memories only the cut and dried principles of the textbooks. Yet so well balanced was his judgment and ability that he wrote at least three of the earliest and best known texts on electricity and magnetism and a-c machinery, so fundamental and so thorough in their treatment that they retained their popularity for more than 20 years. I think this illustrates one outstanding characteristic of Doctor Jackson—he doesn't ride his hobbies so hard or so fast that he fails to keep a rational balance. This student contact with the unknown can only be brought about by a teaching staff which engages in consulting practice or research. Consequently, Doctor Jackson has always encouraged the members of the staff of his department to undertake one or the other of these collateral activities.

A second philosophy or objective has been the creation of a practical system of co-operative engineering education in which the students for three calendar years alternate between semester periods of technical instruction in the engineering school and semester periods of paid but carefully chosen closely supervised industrial work continually increasing in responsibility and fortified by technical engineering instruction two evenings per week. It took many years of painstaking contemplation and statesmanlike negotiation with industrial leaders and faculty to bring this objective to fruition, for not until

1919 at the Massachusetts Institute of Technology did the time seem proper and the industries seem ready to accept a plan which differs so radically from other cooperative plans where the practical work is largely for revenue. This marks other outstanding characteristics of Doctor Jackson—his willingness to wait until the time is ripe for an innovation, his keen sense of when the time *is* ripe, and his ability to negotiate.

The third philosophy has to do with the exceptionally able student. Jackson worried for many years over the seeming defect of the American system which tended to retard the brilliant student to the pace of the average student. Finally he evolved a program modeled along the lines of the English universities' "honors system" but thoroughly recognizing the differences in the two educational systems. The program involves sectioning of all large classes into small groups based on equivalent mental speed of the students, culminating in one group known as the "honors group" who are relieved of all stated class meetings but held responsible through a truly comprehensive examination. This program has now been in effect for some 12 years at MIT in the electrical-engineering department with exceptional success. In this program Jackson found an able enthusiastic collaborator in Gerard Swope who also was interested in the possible application of the English system to our American technical education.

Departments under his charge grew and expanded to notable size, yet Jackson never lost sight of the fact that he was more interested in individuals than in curricula or even subject matter of courses. Busy as he was with the multitudinous duties of an educational executive with between 400 and 600 students in his department, together with his extensive consulting work and his activities in the professional societies, he was never too busy to consult with a student or staff member on any real problem, technical or personal, and to bring his warm personality, rich experience, and cold analytical ability to help toward a solution. Scornful of half-baked ideas and poorly thought through plans, many an associate has been almost literally blown out of the office to think the whole matter over again, yet Jackson was ready with a pat on the back and warm commendation for a task well done no matter how small.

Pride in His Students

I am quite sure that his greatest pride today is not in any one of the many engineering works with which he has been connected but in the multitudes of young men who, having studied and worked under him, have gone out into the engineering, business, and educational worlds stamped with something of the Jackson hall-mark. I recall a summer convention of the AIEE at the New Ocean House at Swampscott in 1929. The Chief had been suffering terribly with a rheumatic attack in his arm. The evening of the banquet the nine others at his table noticed that he was particularly quiet, a bit glum, and did not enter into the otherwise vivacious conversation. He was absorbed in the seating list, and finally began to smile very satisfiedly. Mrs. Jackson said, "Well, Dugald, what have you been thinking about?" and his reply was, "Now, Mabel, do you realize that there are some 50-odd former students of mine in this very room tonight who are presidents of the Institute, past presidents, deans of engineering colleges, heads of departments of electrical engineering, or chief engineers of their companies?" His obvious pride and gratification in the success of "his boys," of whom I am also proud to be one, is proof of my assertion that building men is his greatest satisfaction from a long life of hard driving work.

To epitomize him I can do no better than to use the phraseology of that incomparable master of the citation, President Nicholas Murray Butler of Columbia when he conferred on Professor Jackson the honorary degree of doctor of science in 1932, with these words:

> Native of Pennsylvania, and trained at Pennsylvania State College and at Cornell University; closely uniting industrial experience with scientific research, and, after 16 years of service at the University of Wisconsin, passing a quarter century ago to the department of electrical engineering at the Massachusetts Institute of Technology; active in a score of ways as engineer, as educator, and as administrator; honored at home and abroad for distinction of mind and of service marked by broad vision, boundless energy, and vigorous leadership; a true ornament of our country's scientific endeavor and of its educational force.

Illumination Notes*

Fluorescent Industrial Lamp. Out of the laboratory has come a new, highly efficient 100-watt lamp for industrial lighting. Like the well-known long-tube Cooper-Hewitt lamp, the new lamp is a four-foot tube containing a low-pressure mercury-vapor arc; but the new feature is a fluorescent coating on the inside wall of the tube, which converts the ultraviolet radiations of the arc into light. The efficiency is 50 lumens per watt, about three times that of the corresponding incandescent lamp.

Projector Lamps. Decidedly novel types of Mazda lamps have recently been announced. They are projector lamps having incorporated in the bulb an efficient reflector consisting of a metal coating on the inside of the glass. The reflecting surface is accurately shaped and the filament accurately positioned at the focal point. One type called the "projector lamp" is made with two beam widths. One, giving a strong narrow beam, is designated as the "projector spot lamp;" the other, with a wider beam, is called the "projector flood lamp." The lamps fit the ordinary socket, and are made of hard glass so that they may be used outdoors as well as in. Still another type, with narrow powerful beam, is made of soft glass, for indoor use only. It is known as the "reflector lamp."

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* Contributed for the AIEE committee on production and application of light by L. A. Hawkins (A'03, M'13) executive engineer, research laboratory, General Electric Company, Schenectady, N. Y.

The Balancing of Incentive and Security

By RALPH E. FLANDERS

Certain conditions and trends relating to incentive and security are discussed in this article, which suggests that consideration should be given to various possibilities of stimulating interest toward higher standards of living as well as security.

THE choice between security and incentive is presented in numerous fields and on many scales. This choice has to be made by individuals, by businesses, by industries, by social groups, by nations, by whole civilizations. Nature herself, in the long process of the development of life, has experimented with both principles, offering individual or group security to some species and insecure initiative to others. A consideration of the evolution of living things from this standpoint would be a most interesting undertaking and would be of suggestive value in the study of related human problems; but time and space are lacking for carrying out such a project.

It is proposed that the field of inquiry be limited to these few relationships: that of the individual or organized worker to industry and to organized society, and that of organized society to the destiny of western civilization.

In the first place, not incentive alone with its policies of enterprise and risk, nor security alone with its attitudes of defense and protection, can be considered as satisfactory conclusions of our inquiry, whether for persons, businesses, or government. The taking of too great risks may result in the destruction of the gains of the past. Too great a concentration on security will lead to the wasting away of former achievement and a decay of present advantage. There must needs be a proper balance between incentive and security. Both are necessary. The question before us is to determine what is the proper balance; or, if that be impossible of determination in satisfactory terms, to see as clearly as we can what are the factors which lead toward the determination of the proper balance.

Comparison of American and European Business Organization

One of the most interesting examples of a difference in attitudes toward this question was plainly to be observed in comparing the American and the Continental business organization in the pre-War period. It was then the experience of most of us who were engaged in the manufacture and sale of high-production machinery, that the attitude of the European customer toward our product differed fundamentally from that of the American prospect. The European of that time lived in what seemed on the surface to be a settled civilization. The foreman or shop superintendent or managing director had arrived at a certain place in the social scale. Having attained that place in a well-ordered civilization, he was more deeply concerned with maintaining it than he was in risking it for the sake of possible future advantage. When confronted with an apparent opportunity for making greater profits by the expenditure of large sums of money, his first and strongest reaction was that the expenditure of those large sums was a dangerous undertaking. While it might prove to be advantageous in the long run, yet again it might not. A single serious mistake would jeopardize his position and cost him his assured place in the social scale. There would probably be no complaint whatever if he did nothing; while there was a large chance of failure and consequent disaster if he took the risk. Under these circumstances the normal attitude of that day in thousands of business establishments was that of letting well enough alone. Security triumphed over incentive.

In the America of that day, on the contrary, amid the confusion and turmoil of expanding population and expanding industry, the rewards of place, power, and income went to those who were willing to take risks. So many men of ability were willing to take risks and the risk of failure was so far below the 50-50 margin that those who did take risks as a whole surpassed in the race those who did not. The atmosphere, therefore, was one of incentive.

The author's observation is that a comparison of present-day conditions as between Europe and America reveals much less difference than was apparent 25 years ago. The European social structure is not so well ordered. The security of the inactive individual is less assured. The obvious rewards of initiative and risk are greater. On the converse, in the United States there has been a tendency to take the mature point of view. With the disappearance of the physical frontier and the leveling off of the population curve, the obvious and automatic incentives to expansion are diminishing.

It is not a part of my purpose to explain why I believe that these factors do not of necessity call for a slowing up in our expansion of activity for the next generation; but the fact remains that they are at the moment effective. They are particularly effective when combined with laws and policies of our federal government which dampen enterprise and exalt security; but of these more

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Essentially full text of an address delivered at the Seventh International Management Congress, Washington, D. C., September 22, 1938.

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later. The net result is that the heightened spirit of enterprise in Europe and the lowered industrial vitality here tend to bring the two regions more nearly together than at any time within the memory of men now living.

Two Types of Workers

This problem of the proper balancing between incentive and security affects the relation of the business to its working force in all its ranks, and not simply with relation to those in management. Probably most of us concerned with management have come to the conclusion that there are two broad categories of employees. One is the routine worker whose principal desire is for steady work at good pay. The other type, much smaller in numbers, is spurred by initiative and desirous of assuming responsibility and of expanding his responsibility to the limit of his powers.

These two classes considered in their broad human aspects do not constitute an inferior and a superior class. Both are necessary to industry. If all of us were in one or the other, industry could not survive. Especially should it be remembered that the larger group which looks primarily for security in industry is not the inferior class of the two. In mental equipment, in moral sensibilities, in capacity for the highest satisfactions of life, there will be found at least as many superior individuals among those looking for security as among those spurred by incentive. Industrial management and responsibility is after all a highly specialized form of human activity. Those who are fitted for it are not thereby picked out as being superior human beings. They are simply better adapted to a specialized range of human activities. Let us not make the mistake of concluding that excellence in our particular field means corresponding excellence in the general scale of human character.

A practical management problem arises in determining the amount and kind of incentive to offer this group which constitutes the larger portion of the employees of the individual business. There are limits to the money incentive which can be applied from the purely mathematical standpoint of cost per operation, per piece, or per pound. The limits in desirable income stimulation in fact fall well below this mathematical maximum. Any wage incentive which keeps this group unduly stirred up, whether by unnatural physical or mental effort on the one hand, or by fear as to the security of the wage arrangements on the other, is bad management in the long run whatever the short term effects may be. It is important for these workers that their connection with industry shall be such as to lead to tranquility of mind and self-respect in their position, whether at work or at leisure.

But while there are limits to the monetary incentive, there are no limits to the intangible incentives which may be offered. The greatest available security of employment and of wage income both as determined by private business policy and by the stabilization of our economy are requisites for satisfaction in life to the great body of our fellow-citizens in industry. Those who have lacked opportunity to become acquainted with the workman for whom these conditions have in some measure been provided, will never understand the prideful relationship between the worker and his work which exists among them. The expansion of the conditions in individual business and in our economy as a whole which make this relationship possible will add immeasurably to the general happiness of the nation.

The smaller group is one endowed with initiative and a willingness to take on responsibility; and from this smaller group the ranks of industry leadership are recruited. Such leadership is at its best when, either as viewed individually or as a class, it renounces complete security for itself, but is deeply concerned with security for those in its charge. If that leadership is wise, its own initiative will be tempered by cool judgment and by experience; but yet it will always find itself functioning in accordance with a temperament which reaches out for anything which is unknown and untried, provided it be rationally hopeful. Unless there is enough of this latter element in its mixture of qualities, the interests of those led and of society as a whole will not be best served.

Decline of the Capitalist

The individual positions of the old-fashioned capitalist group continue to become less and less secure as time goes on. In the United States, at least, the heavy incidence of estate taxes and the continued multiplication of the number of stockholders in a given enterprise tend year by year to take the management of our productive wealth out of the category of inherited wealth and put it into a separate management class. We may almost say that the day of the capitalist has passed. Ownership is no longer as a rule vested in powerful individuals. Ownership is continuously more subdivided and fractionated. The opportunities of management are increasingly more and more open to those who can gain them only by other means than by inheritance. This condition is true even though it is possible to point to remaining individual capitalists of the old type. Their number and their importance diminishes yearly. The new profession of nonowning management grows in importance. The means by which high position in management is obtained does not, of course, always assure the best possible men for the work; but the standard is surprisingly high, and there seems to be no doubt as to the desirability of the existing management class as compared with inherited managership as we have witnessed it in its decline. Again, of course, we are using broad general terms, bearing in mind many brilliant exceptions to the general rule.

It would not be proper to leave this topic without calling attention to a third type of fellow human-being—the person who has willingness and even anxiety to accept responsibility, but is unequipped by nature to take it on. Such individuals offer a difficult problem not only to management but to themselves. Sometimes they are persons of ability who have mistaken the nature of those abilities, in which case the remedy lies in redirecting their ambitions and energies. Here it is evident that the bare application of incentive is of little avail. The great need is for analysis and redirection.

Sphere of the Labor Union

The labor union occupies another sphere in which choice has to be made between security and incentive. In some industries the emphasis has been so strongly on security that wage rates and working conditions have been set at a level which decreases the volume of work which is available to that industry at prevailing costs. The result is that those who have work under these conditions fare far better than in the past, but meanwhile many of their fellows are needlessly unemployed and the whole business machinery runs at an unnecessarily low rate of output, employment, and total pay rolls. Thus the whole country falls below the general standard of living of which it is capable.

This represents an extreme of labor-union policy which in its normal and socially needed function is altogether helpful. That necessary function relates to the correction of the evil situation found in industries in which the competition between business organizations is primarily on the matter of wages, thus tending to grind them down to the lowest possible limit. The solution lies in reversing that process by labor-union activity and replacing it by competition in equipment and management whereby high wages can be paid, low prices maintained, the general purchasing power increased, and the standard of living raised.

So far as the industries themselves are concerned, they are seeking a false basis of security for themselves in driving wages down and, in addition, they set up thereby destructive forces in the whole fabric of society. The remedy lies in the direction of greater risk in investment and a consequent insecurity in first appearance. But in the end this provides for the business, for society, and also for the employees far greater security than can ever be obtained by the more reactionary policy.

We must be careful to remember, however, that undesirable labor-union policies are but a reflection of a corresponding policy which has been attempted over and over again by management in industry. Individual businesses who fancied that they were strong enough to do so, either by their temporary dominance of the market or by patent protection or other real or imaginary advantage, have endeavored to capitalize on that advantage by raising the price of the product and trying to get an unduly large profit. Such an attempt at gaining financial security is seldom successful in the long run, even when made by strong groups of manufacturers instead of by individual companies. There is in high profits a strong stimulant to opposing enterprise. Small new firms dig into the market. New inventions and devices come to light which parallel the older ones and injure their monopoly value. Sometimes completely new products are devised which blanket the wind from the sails of the going enterprise, and cause it to fall behind in the race.

This is particularly the case when an old industry endeavors to protect itself. Human ingenuity is limitless, and the endeavor to secure monopoly seldom fails to produce competition of unexpected strength and novelty. In the long run the industry which seeks to secure its position by monopoly and raised prices finds itself at a disadvantage as compared with those industries which work on a lesser margin of profit but depend on energy, good service, and moderate price for their safety.

The best solution, so far as concerns the general prosperity of a country and its standard of living, is thus the same for organized labor or organized industry. The proper balance between security and incentive must be maintained.

The Paradox of Security

What has been said as to the balance of elements between individuals and business organizations, and as between business organizations with each other, applies with full force to the relationship between the individual and organized society. But here we meet with some additional elements of very great importance. One point relates not only to the continuously recurring question as to the proper amount of emphasis to be put on incentive and security, but raises the further question as to the types of experience and activity to which each should be predominantly applied.

Upon examining the course of the history of our civilization, we are faced with a paradox. The succeeding centuries of its development seen in one aspect appear to provide greater and greater security as time goes on. In another aspect the history of the western world seems to be a progress toward more and more delicate balance and greater insecurity.

If we examine the structure of our society, we will discover that the growth in security relates mostly to material things. Civilized nations are less and less subject to famine as the generations pass by. Greater output per acre and per man, crops somewhat less dependent on the weather than in times past due to irrigation and improved methods of cultivation, the elimination of a large percentage of disease and death and even of accident by improved hygiene, medicine, surgery, and safety practices—all these represent consistent gains in security.

The increasing delicacy of economic balance is likewise plainly evident; so evident indeed as to be appalling. This is due to a number of causes, among which are the following:

1. Present-day restrictions on freedom of trade between sovereign countries have restricted the flow of commodities from regions of plenty to regions of dearth, so that local depressions are less easily compensated for.

2. Our money has of necessity shifted from a gold to a credit basis, and in so doing has become dependent for its volume and velocity of circulation on psychological factors which are difficult of control. "Business confidence" cannot be made to order.

3. The spread of popular education has done its part. Hundreds of thousands and even millions of people are following the business

indices who 20 years ago did not even know that they existed. Their purchases are going up and down with the stock market. They no longer act like the classical "economic man."

4. As the standard of living is raised, a larger and larger per cent of the expenditures of the mass of the population goes for goods whose purchase can be postponed. Not only *can* the purchases be postponed, but they *are* postponed, and billions of idle dollars are on occasion hoarded in our banking system that would be in active circulation if the holders of these funds were under any necessity for spending them.

5. The very temper of our civilization is that of tension; and the hair-trigger temperament that goes with our life plays its part in the sudden and unpredictable movements in mass psychology which affect all of the preceding elements.

Truly we live in a delicately balanced society; or perhaps we had better say, in a society perpetually unbalanced and endeavoring, sometimes unsuccessfully, to maintain its equilibrium.

Mechanical Analogy

If we look for a material analogy to this social situation, we find it in the progress of science and engineering. We may, for instance, examine the development of the means of transportation and find it at once becoming more perilous in its possibilities, while at the same time, it becomes ever more safe so far as concerns the actual number of disasters. When man made his way only on his own feet, he was free from innumerable possibilities of accident that went with later modes of travel. Yet the broken leg or other similar accidents must have been of frequent occurrence. When he took to riding on horseback instead of traveling by foot, the number of kinds of possible accidents greatly increased; yet if statistics had been available, it might have been found that there were fewer accidents per horse mile than there were per man mile for the pedestrian.

Perils were tremendously increased with the advent of the railroad. The automobile still further increased them. In fact, our speed and the traffic conditions with which we have to contend, if viewed by anyone seeing them for the first time, would seem to be a wholesale invitation for wholesale slaughter. The accident rate is far too high. It is marvelously low when we consider the possibilities for trouble inherent in the situation. And that low rate is at last beginning to turn lower yet as the driving population becomes more and more skilled in the handling of the car and more and more imbued, by social pressure, with the necessity for carefulness.

The automobile, or the older railroad train, is by no means the most recent development in combined insecurity and safety. Travel by airplane is of all imaginable things the most insecure and the most subject to sudden death and destruction. Yet the figures for accidents per passenger mile on regular commercial flights are astonishingly low—incredibly low. Here we have the combined counterbalancing effect of mechanical improvements and human organization in rendering reasonably safe a means of transportation which, exhibited for the first time, would appeal only to the foolhardy and the reckless.

May we not take some hope in this mechanical analogy and feel that the increasing instability of our society does not debar us from making it increasingly safe by corresponding improvements? Those who refuse to consider these possibilities are fond of saying that you cannot go against natural law. This we cheerfully admit; but within the realm of natural law innumerable novelties have been devised and innumerable successful devices have resulted from the trial of those novelties. This does not mean that in the social field we can safely trust to haphazard experiments. The risks are too great, and a single disaster may have appalling results. It does mean that the application of the same kind of analysis and design to social problems that is applied to the solving of the engineering problems of the airplane may produce comparable results. It may not be hopeless to look for the application of social devices which will prove as effective in promoting the normal operation of our social mechanism as was the simple expedient of giving a dihedral angle to the wings of an airplane in giving a needed degree of inherent stability to the craft when it is in flight. So much for the possibility of the existence side by side of growing instability and increasing security. Let us next ask ourselves over what areas of our social existence should security be applied, and what areas should we leave to the influence of incentives?

Application of Security and Incentive

As one suggested answer to this question, may we not make a division in accordance with the age of the individuals who make up the great body of our fellow citizens? It is within the physical capacity of our civilization, either operated as a whole or in groups or units in part self-sustained, to provide for the population the following kinds of security:

For youth, we seek preparation for life's work and the broadest range of opportunity that it is possible to provide. Nature does not provide equality of gifts and abilities. No social organization has as yet successfully provided equality of income or equality of ownership, unless it be on the basis of a very low standard of living. What we can hold before ourselves as the ideal for youth is the nearest possible approach to equality of opportunity. This is a right possessed by the individual in a democracy. It is more than a right. It is a necessity for the perpetuation of democracy, if democracy is to be perpetuated and if society is to move on to higher service for the individuals who compose it. We cannot afford to allow any talents to go unused and undeveloped. We cannot permit any abilities to lie undiscovered. We must prepare for an era of great expansion of education, not in its mere bulk so much as in the development of new kinds of education to fit more kinds of people in all kinds of situations.

We are, moreover, faced with an emergency which requires that we act now in this matter. With the present varieties and distribution of education, the great majority of students do not carry their schooling beyond the grades. Of the remainder, the majority get through our present high-school courses with difficulty. In the meantime, the age at which the boy or girl may go to work has been raised to 16 years and present tendencies will bring that minimum age before long to 18 years or even older. These empty, unoccupied years at the critical period in the life of the boy or girl constitute a serious menace, not only to the character development and future of the individual, but as well to the state and nation of which he or she will become an effective ruling element under our form of government. This educational problem must become a matter of first importance to us. The youth must be secure in preparation.

At the other extreme of the life span, we have entered a new period of responsibility for old age. It has become a part of our social purpose to see to it that those who have worked faithfully during their years of strength shall, during their years of retirement, be assured of adequate food, clothing, and shelter. This minimum responsibility society is sharing as an obligation with the individual. In so doing we will relieve the middle years of unjustifiable worry for the future, leaving them free to be devoted to the productive occupations by which the programs for youth and old age will be sustained. Age following a productive maturity deserves security.

We have made real progress in these last few years in defining and accepting our social obligations to youth and age. We have failed in developing the policies and institutions, and even the proper mental attitudes, required for such a direction of the productive years of men and women as will make it possible to support these new obligations for youth and age. It is in the reviving and freeing of the effort of the working years that our nation finds its duty and its opportunity.

It is in the middle years that the full force of incentive must be provided and applied. Some security for unemployment, accident, and illness must be provided. But the whole atmosphere of maturity must be that of production, self-support, and the support of society as a whole. But even here, as we have seen earlier in analyzing the different types of workers, the full stress of incentive cannot properly be applied to every individual in the middle years. Personal responsibility for personal well-being must be made possible and emphasized. But the full force of incentive must be left to fall on those who are to lead and direct the needed expansion of our productivity.

For the United States alone, it is the conviction of your speaker that the spirit of enterprise and the response to incentive has been greatly diminished in industrial and mercantile leadership in the period since 1929. This spirit did not revive with anything like its old vigor even during the relatively prosperous year of 1937. Many reasons can be and have been offered for this condition.

The physical frontier has disappeared; the population curve is flattening out; and automatic, irresistible stimuli to business expansion are no longer available. These facts, more or less clearly realized, have perhaps tended to produce a state of pessimism in the minds of American business men. If so, it is a quite unnecessary condition. The physical resources, technical progress, and numbers of our population permit of a great expansion in the standard of living and will require a great expansion in industry to meet it; and it is on this possibility that we must fix our minds. We cannot examine the possibilities too often or point them out too insistently.

The other group of deterrents to a revival of initiative has come from government. On the one hand is the limited point of view of the social worker whose mind is fixed on security alone. On the other is the politician who finds the easy road to maintenance of power that of the promise of security. Security is a much easier thing to provide on a temporary and spectacular basis than is the much more fundamental achievement of a raised standard of living.

What we have to learn is that *there is no long-time security without incentive and initiative.* For a continuance of achievement in our western civilization we must strike a balance between the two policies. We are like an army with new territory ahead of us. If it is unwise to extend the front line too rapidly lest our communications be cut off from the rear and our army destroyed, it is equally unwise to go into a permanently fortified encampment in our present location. This is not a good place to stop. In view of the physical, technical, and human possibilities ahead of us, it is a primary duty of government to bring about within the governmental field the conditions which foster a revival of initiative and enterprise. Our present need is not alone for security but for incentive. On the return to incentive hinges the success of our whole effort to attain a possible and desirable advance in the security of the whole mass of our fellow citizens.

Westinghouse Photo

Engineering Opportunities in Manufacturing

By T. C. JOHNSON
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Electrical manufacturing offers many opportunities for the engineering graduate. Broad, intensive fundamental training rather than specialization is required, because co-ordination of knowledge from various branches of engineering is required. The scope of positions in the industry, ranging from technical to nontechnical by successive steps from research to sales and advertising, is outlined in this article.

ENGINEERING as a profession offers a variety of opportunities in many lines of endeavor, but probably no one other field offers as wide a variety as that of electrical engineering. A statement quoted from the bulletin of information of the Columbia University school of engineering says: "A young man may have in high degree the qualities which in general are essential for an engineer and yet may not have the type of mind which is necessary for the successful practice of electrical engineering on its technical side. There is required a quality of mind and imagination which is able to visualize into practical form the results of electrical theory. It therefore follows that the mind should be of a type to which the analytical theory is not repugnant. Owing to the great and rapid advance in theory and practice, anyone with a strong conservative tendency is at a disadvantage in electrical engineering."

In this article the relative importance of the electrical manufacturing industry to the engineering profession, the diversity and scope of the many possible engineering positions which produce the great variety of electrical apparatus, the interdependence of this industry with many other fields of engineering which have influenced its growth, and the type of educational training this industry demands will be discussed.

To orient the reader, the size and position of the electrical manufacturing industry in relation to the other manufactures of the nation will be investigated. According to the most recent available census reports (1935), the electrical industry furnishes about 2.5 per cent of the total value of manufactured goods. This places it about eighth in rank, being surpassed only by such others as the automobile, steel mill, and petroleum-refining industries. Ranked according to number of wage earners employed it is seventh, while it is third when compared on the basis of value added to the products in manufacture. Only the steel and printing industries add a greater fraction of the total value of their products by the process of manufacture.

Altogether there are about 1,600 concerns in the United States manufacturing electrical equipment, most of them in only one or two specialized lines. Thus it is that there are opportunities in concerns of various sizes, and the question is often asked as to the relative advantages of small and large companies. Because of obvious exceptions to the rule, no final answer can be given to this question except in general terms. Each type of company offers different and varied opportunities and needs good engineers. Any one company also has many positions outside the strictly engineering field which can be filled to advantage by technical graduates. In general, it may be said that the electrical industry serves as a training ground for a large number of engineers who later go into associated fields, and that the opportunity for varied training is greater in the large company than in the small.

Products of the Industry

Let us look at the list of products that go to make up this 2.5 per cent of the nation's manufactures. The principal divisions are appliances, radio, refrigeration, industrial products, transmission supplies, wire and cable, and generation equipment. When these topics are considered in greater detail, a surprising variety is found. There are large and small steam turbines and generators for public utilities supplying light and power; there are transformers, switchgear, wire and cable, and insulators to carry the power to the consumers; there are motors of all kinds for industrial and domestic use; locomotives, streetcars, and subway trains for transportation; and a host of important apparatus such as mercury-arc rectifiers and electron tubes for power and control uses. There are lighting developments of all kinds both domestic and public, electrical testing equipment for innumerable applications, aids to medicine of increasing importance, and, of course, the many well-known appliances for the modern electrified home.

Rather obviously, except for the appliances, which play an increasingly important part, the products of the electrical manufacturing industry are for use by other industries. This means that there must be a close co-operation with these various industries. Application engineers spend their time learning the special needs of one or two industries, applying the proper available equipment to the present requirements of the industries, and translating the future developments into suggestions to the designing engineer. In the case of the sale of a large turbine and its accompanying generator to a public utility, the final delivery is usually the culmination of several years of co-operative work and study of the needs and peculiarities of the electrical system of which the generator will be a part.

Essentially full text of a chapter of a book "Engineering Opportunities," edited by R. W. Clyne of American Steel Foundries, Chicago, Ill.

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Engineering Staff

An industry having this array of products and supplying other industries so highly mechanized must necessarily have a fine staff of engineers if it is creditably to fill its place in the scheme of things. Out of the total number of wage earners in the electrical manufacturing industry (about 180,000 in 1935) the engineers numbered 3.3 per cent. This is a larger percentage of engineers than for any other industry except electric light and power, construction and maintenance of roads, miscellaneous mines, and radio broadcasting. This fact indicates the high degree of engineering supervision required because of the relatively custom-built nature of the products.

Clearly, such a large group of engineers needs to be continually replenished and augmented by new men with ideas. Approximately 25 per cent of the engineering graduates of the colleges of the country enter the electrical manufacturing industry. These new men, it must be emphasized, are not all electrical engineers. There is a great need for mechanical and other engineers, as well. The design of electrical equipment has many problems in mechanical engineering, involving stresses, heat flow, thermodynamics, and so on, so that a good engineer may have to become adept in almost any line of work. For example, an electrical-engineering graduate may eventually find himself wrestling with the intricacies of new developments in power generation by steam and binary systems or working in the development of new materials.

These figures are enough to show that the electrical manufacturing industry is one of the more important from the point of view of value of output; that a large proportion of the final value is added in the process of manufacture; that it is heavily staffed with engineers because of the nature of its products; and that it takes a large proportion of the engineering graduates of the colleges.

Development of the Industry

One of the most interesting studies in history is that concerning the growth of knowledge and use of electricity. The static phenomena of electricity have been known for hundreds of years. Nearly 200 years ago Benjamin Franklin experimented with lightning and Leyden jars, proposed the identity of lightning and electricity, and wondered how to put the then-existing knowledge to practical use. The phenomena remained principally a curiosity until Volta announced the discovery of a new source of electricity in 1800, and Faraday made his essential contribution—electromagnetic induction—in 1831. From then on electricity was subjected to an ever-more intense scrutiny by experimenters and mathematicians.

Only 50 or 60 years ago began the period of great application of electricity to the service of man. In the early '80's many things happened that encouraged the revolution in industrial life which the advent of electric power was to foster. The horsecar had been in service since 1860, and tracks covered nearly 4,000 miles. Transportation by this means already seemed slow and uncertain so that one of the incentives to develop a good electric motor was the need of improving streetcar service.

Important developments came thick and fast. Edison invented the electric lamp and in 1882 opened his Pearl Street generating station, making the worth-while contribution of the three-wire system. The American Institute of Electrical Engineers was formed. Stanley and others invented the transformer, allowing the transmission of power to greater distances than before. The polyphase a-c system was proposed by Tesla, who shortly invented the induction motor. (The possibilities of the induction motor were not realized for some years as there were troubles with polyphase systems and choice of frequency.) The search for new uses, better materials, and better methods led to the development of silicon steel by Hadfield in 1889. Lamme built a motor which has been the prototype of modern machines. Steinmetz unified the knowledge of alternating currents with his method of complex numbers, greatly simplifying calculations. The demand for better light in small quantities, impossible with the arc lamp, resulted in the development of the tungsten filament by Coolidge in 1906. The ever increasing demand for more power for lighting and industrial uses necessitated the development of the large steam turbine, the first one of which went into operation in Chicago only 35 years ago.

CONTRIBUTION OF CONTEMPORARY INDUSTRIES

It is a modern theme of subtle importance that any economic movement of far-reaching effect must have a number of essential and underlying causes. Interpreting the rise of the electrical industry in the light of this criterion, even a casual investigation reveals that in addition to the series of discoveries driven by intellectual curiosity and the excitement aroused by new uses of this new medium, contemporary industry must have provided considerable impetus. In other words, because of the urge to expand and the demand for better goods, the whole social framework was ripe for the very rapid expansion of the electrical industry through its ability to aid the other industries in their progress. The electrical industry grew whenever any other industry grew.

When Edison started his first central power plant in 1882, in New York City, he had a small steam engine and generator capable of supplying power for 400 lamps. Within a month he had trebled his capacity. This growth was prophetic of the electrical industry. In 1937 the central power plants of the United States had an installed capacity of 46 million horsepower, and were supplying nearly 27 million customers. As a further measure of this rapid growth, during the 20 years from 1910 to 1930 when the total number of engineers reported in the censuses was tripling, the electrical and mechanical engineers were gaining in relative importance as shown by the following percentages of the total:

	1910	1920	1930
Mechanical	16	28	24
Electrical	17	20	26

Much of this great gain in size and importance can be attributed directly to the influence of the various industries for whom electricity is an ideal servant. To pick only a single instance from the many cases of such industrial co-operation, consider the effect of the rise in the automobile industry. Directly affected were the steel, glass, machine tool, and rubber industries; indirectly, many others. Each of those in turn reacted on the electrical industry by demanding more motors and generators for mechanical drive, mine hoists, ship propulsion, machine tools, control equipment, lighting, and so on ad infinitum. The growth of one went hand-in-hand with the development of the other.

Recent technical progress in the electrical industry has been principally in the improvement and enlargement of existing types of apparatus. Hydrogen cooling has been used for large generators to allow the production of more power from the same volume of machine, small motors have been protected by built-in thermal overload switches to give more economical use of the motor's working ability, better vapor lamps and bigger electric locomotives have been built, better magnetic alloys have been developed. This continual and radical improvement in all lines is characteristic of the industry. Probably the greatest recent trend in the use of electricity has been the growth of home electrification, including its use on the farm. The net result has been a constant increase in the use of electricity in the home and in industry, requiring better and better engineering to produce better results for less money.

Characteristics of the Industry

One of the most important questions asked by engineering graduates, undergraduates, and prospective engineering students is "What kinds of engineers are needed by industry, and what do they do?" An even more fundamental question concerning any particular industry is, "What are its characteristics and how do these characteristics affect the type of engineers required?"

The fundamental element of the electrical industry—electricity—is exceedingly adaptable to the uses of mankind, but because of its impalpable substance and the nature of the laws it obeys, its economic application depends on the mastery of a great deal of higher mathematics, combined with careful training in the several branches of engineering. Fundamentally, then, this industry needs well-trained engineers.

In the second place, since the myriad uses of electricity involve a great many different kinds and sizes of apparatus —from the Boulder Dam generators to the small electric mixers for the kitchen—many different materials are required because of their special qualities—light, strong alloys, magnetic alloys, plastics, insulation, and so forth. Thus the industry needs engineers who are familiar with the technology and possibilities of these numerous materials.

The third important aspect of the industry is that its interdependence on other industries requires and contributes to the great number of new designs which are brought out each year by other manufacturers. The obsolescence of the driven machine is a powerful stimulus to progress in the electrical industry; greater, indeed, than that of new-found uses. For example, the advent of the continuous-strip steel mill necessitated the installation of some 25,000 to 40,000 horsepower in electric motors and generators. These were not new uses at all, but required many new designs and involved electrical, mechanical, and thermal problems.

It should be clear, then, that the industry needs a great number and variety of technical engineers—electrical, mechanical, chemical, metallurgical—as well as production, management, and sales engineers. This refutes the common notion that the electrical industry needs only electrical engineers. All of these engineers must eventually have a common outlook and uniformity of general ability not necessarily indicated by their engineering "labels," for their work is highly co-operative. This will become increasingly evident later in this article.

Types of Engineering

Any attempt to label and limit the types of engineering done in any one industry runs into this obvious difficulty: except on paper there is no exact demarcation. All engineers, salesmen, and managers must possess to some degree the abilities of engineering, salesmanship, and group planning. If titles must be chosen, the jobs which emphasize technical engineering are in research, development, design, and application; those emphasizing other abilities but also requiring engineering ability are in sales, management, and patent law.

RESEARCH

Research, as commonly thought of, is what is more strictly called scientific industrial research. This is done in a relatively small number of laboratories by men highly trained in physics and mathematics, who spend their time investigating the fundamental phenomena of our world in those lines where the information might be of subsequent value to engineering. A knowledge of the characteristics of arcs and electric discharges may lead to better circuit breakers, improved welding, more uses of electron tubes for control and power transmission. A study of the structure and properties of metals may lead to better steels, stronger magnetic alloys, and metals for special uses.

This type of research worker has been described in many articles and needs no further elaboration here. The work is not engineering in the strict sense of the word, for neither time nor money is a vital ingredient. But the work is essential to engineering progress.

The work of the men who carry forward the complicated analyses of electrical machines, who experiment with and calculate the performance of radically new designs of power plants using high-pressure steam, or mercury-steam cycles, and who plan better systems of control and co-ordination of the very complicated interconnected central power plants, might be called engineering research. These men are comparable to scientists in viewpoint and breadth of training, but they are connected very definitely with the engineering job of doing specific tasks better than before. They bear the burden of the pioneering engineering which must constantly digest the new-found facts of the scientist, advance the mathematical basis of the engineering involved, and, with the co-operation of many other men, begin the development of the machines that will mean material progress for all. This group is always rather small.

DEVELOPMENT

The gulf between the suggestion of an idea and its emergence as a working device is bridged by the development engineer. Usually such an engineer is clever with his hands and is sufficiently imaginative so that difficulties may be foreseen and forestalled as the work proceeds, for there are numberless snags that must be worked out before a device can be manufactured to sell in profitable quantities. As an example of this type of work there is the development of a continuously indicating device for giving the torque and horsepower output of a marine turbine driving a ship's propeller. The idea is simple enough: two similar generators are fastened around the propeller shaft at a known distance apart and their output voltages connected in opposition. The magnitude of the net voltage will depend on the speed and the phase angle between the generator voltages (proportional to torque), thus representing horsepower. However, the difficulties of carrying out this idea are numerous. The mechanical construction is tricky because of close tolerances required by the electrical characteristics desired; the propeller shaft is not conveniently small; vibration and stresses must all be considered. The electrical design of the generators and indicating instruments is difficult because of the necessity for avoiding expensive equipment and maintaining reasonable accuracy. It is clear that the development engineer must not be restricted to electrical-engineering knowledge alone, but needs mechanical and thermal engineering as well as a knowledge of shop processes.

DESIGN

Design is a much maligned word. It is quite probable that students in college have a poorer conception of this phase of engineering than they do of any other. Its connotation has grown to mean something like slaving at a drafting board, whereas the major task of the designer is to create a product that fits the desires of the customer as nearly as possible, can be built and sold at a profit, and embodies as many of the advantages of new materials, new methods, and improved appearance as possible. Whether the designer works at a drafting board or not, he is creating. His work with small apparatus may range all the way from the thoughtful combination of standard parts to fill slightly off-standard requirements, to the downright invention of a device to circumvent a baffling trouble. His duty at all times is to design a line of standard equipment that will fill as many conceivable demands as possible. When dealing with large apparatus or with any line that cannot be built and stocked as standard units, the designer has only past experience and his own calculations to guide him. Frequently new apparatus presents unforeseen difficulties.

From this it may be realized that a designer cannot be restricted to any one type of training. He must be able to analyze the electrical, mechanical, and thermal problems involved so that his own device may do its job, and so that it may fit in with whatever machine it must operate. Ease of manufacture and appearance of the finished product are often of great importance. The designer's knowledge need not be all-inclusive, but he has the responsibility for obtaining a good design wherever the information may be obtained. This indicates that a very broad and basic training and understanding is required. "Routine" is a word often associated with many jobs. No design job need be routine if it is realized what responsibilities and possibilities are open to those who are qualified.

The designers, in electrical apparatus manufacturing, constitute the largest group.

APPLICATION AND SALES

The gap between designer and customer must be filled by one or both of the following men: application engineer and salesman. Clearly, the man who is to satisfy the wants of the customer must know the products of the designer. An application engineer functions chiefly in the apparatus field (supplies to industry) and has the duty of becoming intimately acquainted with the problems of one or several industries, thereby becoming almost a consultant for them. This group of engineers is small since comparatively few men are required to serve a large field. Such an engineer must be ready to decide impartially on the proper motor, generator, turbine, rectifier, or control device for any need that may arise. In doing this, he works with the salesman handling the order or proposition. One of his more important jobs in relation to the manufacturing company for which he works is to help its designers keep abreast of the new developments in his industrial field. This type of work usually requires experience in one or more design departments and a considerable degree of association with the industry to be served. This association may be with the central station, industrial, or transportation fields.

Engineering is sometimes rather arbitrarily divided into two groups: technical and nontechnical. The types of engineers just described are classified as "technical," while such men as sales, advertising, and management engineers are "nontechnical." Both kinds of men must have similar talents, differing only in degree. The designer who does not know how to make his product easy to manufacture and sell, and who cannot convince others of these points, is in the same trouble as the salesman who does not understand and appreciate the technical excellence of his line.

Sales engineering consists of both advertising and actual sales work. These require emphasis on the special talents of salesmanship, handling of people, and fluent expression of ideas, both orally and in writing. However, in an industry producing machines involving as much engineering as electrical equipment does, it requires well-trained engineers to sell. Thus, first of all, the sales and advertising men must be engineers. Usually they are men who have begun with the rest of the engineering graduates, testing electrical equipment, possibly with one of the larger manufacturers, and have then had some experience in one of the engineering offices to provide a good knowledge of the equipment they are to sell. A salesman of this type does not do "house-to-house" selling. He becomes familiar with the users of his equipment in his territory, learns their problems, their plans, helps them decide on the material they need, makes sure the equipment really is fitted for the job it must do, and often follows it up to be sure that all is operating properly. A salesman to a power and light company will know the extent and power of its systems, the sizes and voltages of the power lines, the state and trends of the loads supplied by neighboring companies, and so forth. Possibly he will even observe the direction, strength, and intensity of lightning storms.

A salesman of small equipment knows what similar industries are doing so that he is ready to advise his customers intelligently. He must consider himself technically responsible for seeing that the customer gets what he needs, whether or not that is the equipment that was asked for. Customers in the electrical industry, as in any other stable industry, place repeat orders, and that means that good salesmanship must be combined with good engineering.

The advertising man promoting the sale of technical products usually works from the home office, and has duties similar to those of any other advertising man. He plans the campaign which will best help the district salesmen with the particular equipment they are selling. The distinguishing feature here is that, as before, the advertised product has been highly engineered and is sold to engineers, so that the responsibility of the advertising man is rather obvious—he, too, should have a good technical background. It goes almost without saying that the ability of expressing oneself clearly, accurately, and concisely (which must be a part of every engineer's training), is most highly developed and necessary in the advertising and sales engineers.

Home-Appliance Industry

In the preceding discussion it has been almost tacitly assumed that the equipment mentioned was power apparatus sold to other engineering industries as contrasted to home appliances which are sold more or less directly to the final user. What of the appliance part of the electrical industry? There the story is very similar, differing only in degree. The designers and development engineers must work in close co-operation with the distributors if the products are to be technically correct, economically possible, and soul-satisfying to engineer and housewife alike. This might be called a specialized field, but it must be emphasized that, along with the special and very necessary talents of advertising, sales promotion, market analysis, and psychology, there must be sound engineering.

Management Problems

More and more in industry and college there is mention of the engineering problems of management. The idea of scientific management is not a new one, but it is only within fairly recent time that the press of competition and the ever-increasing degree of engineering required for electrical equipment has forced careful planning and synchronizing of engineering, manufacturing, and selling. Management, of course, has to see that designers keep abreast of the field, that products are those that are being demanded, materials and workmen move along at a pace commensurate with the time limits set by the contracts, that expenses due to overhead, stocks, and production methods are kept down, that workmen are satisfied, and that the right men are in the right jobs. This sounds like a hodge-podge of duties, but there is always the simplifying principle that good engineering includes thoughtful planning—and again the basis for a good manager is a broad technical training so that no oversights nor hindrances may occur on the technical side. From then on it is a matter of engineering intelligence applied to the direction of men (actually much the more difficult of the two problems).

For example, consider management problems occurring in two diverse lines of manufacture, such as large turbines, and small control relays. Turbines, in general, are custom-built, vary from one another in any number of details, and take from six months to two years to produce, depending on the extent to which existing designs and material stocks may be used. The high degree of engineering required for a large turbine, where one-half of one per cent in efficiency may be a deciding factor in the purchase, necessitates the presence of a large and well-trained engineering staff, a large crew of experienced workmen, and all the necessary tools and materials. Management must plan production over at least a two-year period—completely analyzing the design before construction is begun and increasing personnel and stocks to match the progress of the contracted work. In short, long-range planning to maintain a high degree of precision in a large machine is the keynote.

With the small control relays, on the contrary, management is concerned with a device that is manufactured in quantity. Competition is keen, so costs must be kept down, but the product must do the job well and cheaply. Whereas the turbine could be and had to be calculated completely and predicted because of the great unit cost, the relay may be partly calculated and partly developed experimentally. (The final degree of engineering is not so different in the two cases, but the amount per unit of production is very much greater for the turbine.) Designs must constantly be improved; new features, new materials, new methods must be used. Management is responsible for the integration of the combined efforts of engineering and manufacturing staffs to achieve these results. Great emphasis must be laid on the proper scheduling of work so that orders may be turned quickly into finished goods. When the relays are used in combinations (as for starting control of motors), then not only must the unit devices be accurate, but the composite equipment must work smoothly and well. In short, management must schedule both the engineering and production, synchronizing both to eliminate each bit of waste time and material in the interest of low cost.

The mere mention of the professions of patent law and field or service engineer should remind any doubtful person that many more types of jobs than have been discussed here require engineering as a basic training.

Engineering Problems

The products of an industry are as indicative of the engineering required as are descriptions of the various engineering jobs. The introduction to this article indicates the extent of the field, and further lists can be found in any handbook. In a field as broad as that of electrical manufacturing it is impossible to discuss all the varieties of products in any reasonable amount of space, so an attempt will be made to outline the engineering required for a representative product—a medium-sized general-purpose induction motor.

Such a motor must be part of a standard line of motors so designed that any one will supply all reasonable demands for torque and horsepower. Further, the number of motors in the line should be minimized without having to use much too big a motor for any one job. This requires careful proportioning of the entire line and sets close limits to the variation in size possible for any one motor. Each motor must deliver the specified torque and horsepower at the proper speed with good efficiency, good power factor, and low current drawn from the line, without exceeding a reasonable temperature rise.

Proportion and physical size limit the amount of material that can be used. For that reason it must be used to the best advantage. The design is a continual process of compromise and reconciliation of conflicting factors. The electrical characteristics themselves involve considerable adjustment between the amount of iron, the number of turns of wire in the coils, and the flux density. For example, to increase the torque requires more flux, which increases the heating and the no-load current and decreases the efficiency unless a larger motor is built. A motor must not only have good running conditions under load but must be well-behaved at no-load and starting. Often power companies limit the maximum starting current that may be drawn, in order to prevent excessive voltage-drop in the lines.

The electrical problems are difficult enough but there are mechanical and thermal problems as well. The motor must be light and strong, must have good bearings, resist vibration and not itself produce any. The windings must be fastened securely and must resist possible abuse and poor working conditions. Heat generated in different parts of the machine must be removed without allowing any part to get too hot, for the life of the motor is determined by its insulation, the life of which in turn is a critical function of the operating temperature. The motor must be quiet, particularly if it is to drive fans or air-conditioning equipment. The present trend for increasing the horsepower developed by a motor of a given frame size is intensifying the foregoing problems. Their successful solution requires the close co-operation of electrical, mechanical, chemical, thermal, acoustical, metallurgical, and production engineers.

Prerequisites in Training

This discussion of the kinds of engineering encountered in the electrical manufacturing industry emphasizes the fact that a good background in engineering is needed by all who have contact with engineering work. A broad but intensive fundamental training is preferable to specialization, because one must know something about many fields. Moreover, every company has special information that will have to be learned when needed.

Finally, it can hardly be emphasized too strongly that every type of engineer must be able to express his ideas fluently and forcibly, either in writing or by the spoken word. His ideas will be of little value unless transmitted intelligibly to other people. But first of all he must be a good engineer.

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3. Engineering—A Career, A Culture (a pamphlet), The Engineering Foundation, New York, 1932.

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Recent Developments in Electrical Units

By A. E. KENNELLY
HONORARY MEMBER AIEE

Actions have been taken recently by international bodies toward adoption in 1940 of new absolute unit standards for electrical quantities. A brief outline of the development of international standards and of the significance of the change are given in this article by an outstanding authority long active in this field.

IT IS proposed here to present a summary of the actions taken by the International Electrotechnical Commission advisory committee number 24 on electric and magnetic magnitudes and units (EMMU), June 23–24, 1938, in the plenary meeting at Torquay, Devonshire, England, with such brief historical outline as may enable electrical engineers who have not attempted to keep in touch with the development of the meter-kilogram-second (mks*) system to follow the most recent decisions.

The International Electrotechnical Comission

The IEC was brought into existence by a motion from the chamber of delegates to the International Electrical Congress of St. Louis in September 1904.[1] The work of organizing the IEC was promptly taken up by Colonel R. E. Crompton, who now in his ninety-fourth year is still living in England. It must be a great satisfaction to him to see how internationally important his IEC has become during his lifetime. The general secretary since the first meeting for organization held in London in 1906, has been C. LeMaistre, London, to whose invaluable services the IEC has been so greatly indebted. The present international president of the IEC is Professor L. Lombardi of Rome who not only was a member of the committee of the St. Louis congress which recommended the formation of the IEC but has remained an active supporter ever since and has done much notable work in preparing an international IEC vocabulary of some 2,000 technical terms, the first edition of which was accepted at Torquay.[2]

Twenty-seven nations now are affiliated with the work of the IEC, each nation maintaining a local national committee with its own officers. Plenary meetings of the IEC have been held in a number of cities of the world. The most recent, the ninth, was held at Torquay in June 1938. At these plenary meetings the international decisions on electrotechnical matters are formulated and adopted.

The work of the IEC is divided among some 25 advisory committees with their secretariats situated in different countries. The advisory committees agree to hold their own meetings about twice a year between plenary meetings; numerous such meetings have been held. A very large amount of international electrotechnical standardization has been satisfactorily effected by the IEC during its 33 years of existence, to the benefit of all countries. Even a brief summary of these actions would be too long to present at this time. Its actions are substantially unanimous. Those questions on which opinion appears to be divided are set aside until substantial unanimity can be secured. The IEC authorizes the convocation of International Electrical Congresses, the last of which, the eighth, was held at Paris in 1932 to mark the semicentennial anniversary of the first Congrès International des Electriciens in 1881. All the official actions of the IEC are published in two languages, English and French. Any third official language might be devastating in its effect as even the maintenance of two languages has been found to be very onerous to the institution.

Brief Historical Outline of the Giorgi MKS System

Professor G. Giorgi of Rome conceived and published the mks system in 1901. In 1904 he presented a paper on the subject to the International Electrical Congress of St. Louis.[3] He showed that by taking the *meter* instead of the *centimeter* as the unit of length, and the *kilogram* instead of the *gram* as the unit of mass, retaining the mean solar *second* as the unit of time, with an appropriate fourth fundamental unit, the centimeter-gram-second (cgs) system became converted into an absolute system including all of the practical electrical units thus far adopted, in simple one to one relationship, thereby eliminating the numerical factors 10^7, 10^8, 10^9, etc., which connect those practical units with their basic cgs units, thus simplifying the work of the electrical-engineering student. Thus a *kilogram* mass ($m = 1$),

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Prepared especially for ELECTRICAL ENGINEERING.

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The author is indebted to the following persons for valuable suggestions and amendments: Doctor C. H. Sharp, president of the United States National Committee of the International Electrotechnical Commission; Doctor L. J. Briggs, director of the National Bureau of Standards, and members of his staff; C. LeMaistre, general secretary of the IEC; Professor L. Lombardi, president of the IEC; and M. A. Pérard, director of the International Bureau of Weights and Measures at Sèvres.

*In international usage, italic capital letters (*C.G.S.*, *M.K.S.*) are the accepted abbreviations for systems of units. This article has been modified to conform to American standard representations.

1. For all numbered references, see list at end of paper.

moving freely at a velocity ($v = 1$) of one *meter per second* relatively to its environment, possesses a kinetic energy, $mv^2/2$, of $^1/_2$ *joule* for the mks system just as a mass of one *gram* with the velocity of one *centimeter per second* has corresponding kinetic energy, $mv^2/2$, of $^1/_2$ *erg* for the cgs system.

The advantages of the mks system were recognized by the EMMU committee meeting of the IEC in 1930. At a meeting of the United States Committee of the International Physical Union (IPU) at Chicago in 1933, a resolution was passed favoring the adoption of the mks system. Later in 1933 the EMMU committee met at Paris and endorsed the Chicago IPU resolution referring the question of the mks system to the consideration of the various national committees of the IEC. In 1935 the IEC plenary meeting at Scheveningen-Brussels adopted the mks system without settling the question of "rationalization," appealing to the IPU and to the International Committee of Weights and Measures for an opinion as to the best fourth basic unit for the system.

IEC Plenary Meeting at Torquay in Relation to EMMU

Advisory Committee Number 24 of the IEC convened at Torquay on June 23–24, 1938. Torquay is hallowed to all electrotechnicians as being the residence for many years of Oliver Heaviside, the great master of applied mathematics. Fourteen countries were represented by delegates to the total number of 29 (Argentina, Australia, Czechoslovakia, Ecuador, France, Germany, Great Britain, Holland, Italy, Norway, Poland, Roumania, Switzerland, and the United States). The sessions were presided over by Doctor Clayton H. Sharp, president of the United States National Committee, the secretariat for the advisory committee number 24 being situated in the United States.

The following actions are quoted from the original minutes of the meetings:

1. The minutes of the preceding meeting of the committee held at Scheveningen-Brussels in 1935 were read and approved. At that meeting the IEC formally adopted the Giorgi MKS system without opposition, after the subject had been thoroughly discussed by the various national committees for several years.

2. The question of the rationalization of the MKS system was laid on the table and deferred for future consideration. There has been much difference of opinion in all countries as to whether the Giorgi MKS system should be rationalized or unrationalized. The decision turns upon the question whether the MKS unit of magnetomotive force should be the *ampere-turn* or the *ampere-turn*/4π. The same question had been purposely left unsettled at the Scheveningen-Brussels meeting of 1935 for fear of producing dissension detrimental to the general acceptance of the system if a vote were taken upon the matter at that time. It is hoped that in the course of a few years electrotechnical opinion may become crystallized upon the matter, permitting a nearly unanimous vote to be secured.

3. The committee, noting the concordant replies of Comité Consultatif d'Electricité and of the Symbols, Units, and Nomenclature (SUN) Committee of the International Union of Pure and Applied Physics as to the choice of a fourth unit in the Giorgi MKS system, agreed to recommend, as the connecting link between the electrical and mechanical units, the permeability of free space with the value of $\mu_0 = 10^{-7}$ in the unrationalized system or $\mu_0 = 4\pi \times 10^{-7}$ in the rationalized system. The committee recognizes that any one of the following practical units, *ohm, ampere, volt, henry, farad, coulomb, weber* already in use may equally serve as the fourth fundamental unit, because it is possible to derive each unit and its dimensions from any four others mutually independent. (Note: The necessity for high accuracy has usually led the national laboratories to base the realization of the absolute units on determinations of the absolute *ohm* and the absolute *ampere*. For purposes of technical measurements, however, the practical standards are generally those of resistance and electromotive force as they have the advantages of portability, simplicity, and accuracy in use. Standards of these two quantities are maintained by the Bureau International des Poids et Mesures at Sèvres.)

4. The committee voted upon the question, appearing in the agenda, of adopting the name *newton* for the unit of force of the Giorgi MKS system, (10^5 *dynes* in the CGS system or roughly the weight of one *hectogram* of matter, or more nearly 102 grams, at sea level). The vote was ten to three in favor of the motion, with one country abstaining, subject to confirmation by the various national committees under the six-months rule. The ten accepting countries were Australia, Czechoslovakia, Ecuador, France, Great Britain, Holland, Poland, Roumania, Switzerland, and the United States.

5. It was voted that the name of the system should be the Giorgi (MKS) system and Professor Giorgi, who was present as an Italian delegate, was requested to prepare a further memorandum explanatory of the use of his system.

The preceding resolutions were forwarded to the committee of action of the IEC and formally accepted in plenary meeting. For further particulars the reader is referred to the forthcoming official minutes of the IEC Torquay meeting as appearing in the French and English texts.[4]

International Committee of Weights and Measures at Sèvres

By an amendment to the Convention of the Meter formulated at the General Conference on Weights and Measures of 1921, authority over electrical units was assigned to that conference and its subordinate organizations, the International Committee and International Bureau of Weights and Measures. The Weights and Measures Conference acting on reports from the various national physical laboratories decided that the specifications for the international standard *ohm, volt, ampere,* etc., set up by the Chicago congress of 1893 and elaborated by the London conference of 1908,[5] had not met international requirements to the degree of precision desired. It directed the International Committee of Weights and Measures to set aside the "international" standard series and specifications in favor of new standards based upon new absolute measurements of the absolute practical units embodied in wire resistance coils of improved construction and improved standard Weston cells, made by the national physical laboratories. Copies of these new "absolute" standards are to be deposited at Sèvres so as to permit of ready intercomparison. It had been found that the "international" *ohm* and "international" *volt* prepared in the national laboratories of any one country according to the specifications of 1893 and 1908 differed slightly and were also subject to small but distinct changes with time so that the "international" *ohm* of one country might differ from the "international" *ohm* of other countries by amounts considerably in excess of the observational errors of comparison.[6,7] The countries taking part in the production of the standards of the absolute practical units were France, Germany, Great Britain, Japan, Union of Soviet Socialist Republics, and the United States.

The International Conference of Weights and Measures is required by treaty to meet in Paris, ordinarily at regular intervals of six years, so that its next meeting is projected for 1939. The International Committee on Weights and Measures, the president of which is the well-known scientist Professor V. Volterra of Rome, meets every two years at the International Bureau of Weights and Measures at Sèvres. The Bureau under the direction of M. A. Pérard maintains the prototype standards of length and mass—the international *meter* and international *kilogram*. It is ultimately proposed to maintain also at the Bureau standards of the practical absolute electrical units based upon the values of the standards from the national laboratories as well as international standards in photometry and thermometry.

In 1935 the International Committee of Weights and Measures with the aid of its Comité Consultatif d'Electricité issued a table of probable ratios between the "international" and the corresponding "absolute" units, to four decimal places (see table I).[8]

It was recommended by the international committee that the new absolute units at Sèvres should go into effect on January 1, 1940, also that the pre-existing standards in various countries should not be altered but that the new standards after January 1, 1940, should conform to the finally established mean ratios. At its meeting in 1937 the international committee announced the revised provisional ratios carried to five decimal places, obtained up to that date from the national physical laboratories, as follows:[9]

one international mean ohm = 1.00048 absolute ohm
one international mean volt = 1.00036 absolute volt

From these it may be inferred that the mean international ampere is 0.99988 absolute ampere and similarly the ratios for the other electrical standards are derivable. Not all of the co-operating national laboratories had completed their comparisons at the date of the 1937 meeting so that the above ratios to five decimal places are not yet final.

It has been supposed by some that the mks system could not be employed until the standards fixed upon at Sèvres had been put into effect in 1940, but it is evident that the actions to be taken by the International Committee of Weights and Measures do not affect the theory or application of the Giorgi mks system but only the international standards of the absolute units to be maintained at Sèvres. The mks system is now ready for use by students and writers, after they have decided whether in electromagnetics their units shall be rationalized or unrationalized. A corresponding choice, in this respect, has also to be made by those who use the cgs units. Textbooks are in course of publication for illustrating the use of the mks system to students and articles upon the elementary application of the system will no doubt appear in technical journals from time to time in the near future.

The original British Association for the Advancement of Science (BA) *ohm* adopted provisionally at the Paris congress of 1881 represented the resistance under standard specifications of a uniform column of mercury approximately 104.8 centimeters in length. Following the commission's report of 1884 the BA *ohm* was replaced by a new ohm called the *legal ohm* of approximately 106.0 centimeters, an increase of more than one per cent. By the action of the Chicago congress of 1893 the *legal ohm* was replaced by the *international ohm* of approximately 106.3 centimeters, representing an increase of about one-quarter of one per cent. Under direction of the International Conference of Weights and Measures the *absolute practical ohm* in the form of standard coils is expected to correspond approximately to 106.25 centimeters, a reduction of about 0.05 per cent or in the ratio 1/1.0005. The corrections to be made in the other electrical standards are all smaller than those in the standard *ohm* with the exception of the *farad* and *henry* whose corrections are the same as for the *ohm*.

Table I

International	Absolute
Ampere	0.999 9
Coulomb	0.999 9
Ohm	1.000 5
Volt	1.000 4
Henry	1.000 5
Farad	0.999 5
Weber	1.000 4
Watt	1.000 3
Joule	1.000 3

The readjustment of the electrical units effected in 1885 and 1894 did not give rise to any serious amount of confusion or misunderstanding. The corrections due to be made in 1940 will be insignificant from the standpoint of ordinary electrotechnics but in electrophysics will need to be taken into account by numerical coefficients when accurate measurements are required.

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Management's Responsibilities to Society

By A. W. ROBERTSON
ASSOCIATE AIEE

Society often has decreed regulations and restrictions that hamper management and private enterprise; but society is the sole arbitrator of what it considers right, and management must conform, says this chairman of the board of a leading electrical manufacturing company. He emphasizes the vital importance of private enterprise in modern life and the dependence of successful private enterprise upon good management.

MANAGEMENT is to be found everywhere. In our homes, in our personal affairs, in our factories, and generally throughout all social functions; economical, political, or otherwise. And if a thing is thought to be devoid of management someone is always popping up to inject a little management into it, such as making a managed currency or a wheat crop or managing the supply of cotton, the number of pigs, and everything in general. Unfortunately, the various efforts of management do not always harmonize. In fact, more often than not the efforts of different managements are in conflict with each other so that if one management succeeds, the other must necessarily fail. The hunter of seals is directing all his managerial ability to killing seals. Government may be devoting all its managerial ability to keeping the seals alive.

Management has been in existence as long as civilization. But in the present age management controls larger groups than in any other age. It is only during the last fifty years that we have seen organizations of national and international scope. Today we think of management as the organizing force in the world of affairs. It is the *know how* of business and industry. It is concerned with order, discipline and accomplishment, and is against disorder and inertia.

Practical Definition for Management

Management uses the intelligence, labor, and wealth of man with the materials and forces of nature to produce things or services which other men want. It is absurd, in a sense, to define management to you, but in another sense it is a wise precaution to insure our common approach to the subject. Management is the last and best means by which man, the builder and creator, takes the manifold riches of nature which, in their raw or natural state, are useless to him and molds them to his needs. The distinction between the work of management and the work of an individual is that the results of management's activities are always for others. To survive, management must produce what others want, whereas the individual more often than not, is concerned with producing what he alone wants. The multifarious activities of management are beyond description, and some of the activities might be called mismanagement.

Management is necessary to sell a steam boat or a Fuller brush; to run a hat-checking concession or an automobile factory; to operate the Pennsylvania Railroad or a beauty parlor; to give a picnic or conduct a funeral.

Management will function in Europe or Africa, but it prefers civilized communities. The higher the standard of living, the better management functions. Or restated, the better management functions, the higher the standard of living.

Our attention is directed to that part of management which has to do with private enterprise.

Management enables man to advance through the helpful co-operation of other men. Alone he is pitiful. At best he is little more than an animal, and no matter how brilliant he may be he cannot rise far without the help of others. He is born naked and helpless. He travels but a short distance and is tired. His strength wanes unless he is fed. He may know much, but the wisest man has explored only a little bay on the shores of the great ocean of knowledge. Only in the union of minds under capable management does he become supreme. Management unites individuals in effective co-operation. The corporation is the modern vehicle for this purpose. Through it the widow's mite aids the laborer to produce what the consumer wants. Management acts as steward and trustee for all—investor, laborer, and consumer. The results are astonishing. The laborer has received the highest wages for the shortest hours. He has at last found leisure and has become a consumer. He now knows comfort and has luxury. He is unable to appraise his condition as there is nothing in all history with which to compare it. This is true even though there are 10,000,000 persons unemployed in the United States. The unemployed today is better off than was his brother of former ages when employed.

The consumer has been furnished with goods and services which have added to his bodily comfort, relieved him of work and worry, lengthened his life, and benefited him generally. The investor has found management enterprises a safe place in which to invest his funds with profit, not only to himself but to the world at large. The

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Full text of a paper presented at the Seventh International Management Congress, Washington, D. C., September 19–23, 1938.

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securities of private enterprise are the backbone of our insurance companies, investment trusts, and the private wealth of our citizens. However, notwithstanding his present-day luxuries, man still feels naked to the world and longs for security. Although his environment has changed, he has not changed.

Management Must Be Alert to Change

Management has no right of way. It thrives or languishes at man's decree. It has a difficult task. It must be alert to an ever-changing world and must change with the times. Unless it succeeds in doing this, a private enterprise must fail. It must therefore have freedom to try new ways and improve old ways. Any restrictions which destroy its initiative will ultimately destroy it. Here lies the great threat of government against management. Government is the great enemy of initiative. Its chief duty is to make rules and regulations, and every rule is a curb on freedom and danger lies in making everything and everyone conform to a type.

At the present time, government everywhere is endeavoring to force all men to be equal by restraining the strong and assisting the weak. All fair-minded persons will agree that there are times when the strong should be curbed and the weak should be aided, but it is obvious that restraint checks initiative and too much supervision destroys it, whereupon all true management activity ceases.

The world is founded on faith and integrity. The goods and services of management are accepted generally upon their face value. I trust the men who make the automobile I buy, and I do not know any of the thousands who have contributed to the finished product. When I step into an airplane I trust my life to the organization which built it and to the pilot who operates it. When I receive a telegram I do not question the integrity of the message.

Management must be honest, capable, and wise, even as you and I, and its goods and services must be worthy of highest trust; but it must also accept the task of leadership in the conquest of our natural world. Man must combine his forces to win. Nature is relentless. It will reclaim every secret and recapture every stronghold our age has won unless we are alert to hold it and press on to new victories. It is pleasant to be complacent, but other civilizations as proud as our own have gone down leaving only broken fragments to tell the story of their glory. Through wise management of our abilities and resources we have advanced far beyond any previous frontier, but what we have gained can be lost. And it will be lost, and retreat will be inevitable if the attack against business succeeds in curbing management and killing initiative.

Management has served best in free countries. The United States has been ideal for its development. Here the best talent is drafted from 50,000,000 workers. The managerial type of person is rare. It is not enough to be intelligent, industrious, and trustworthy. The management of a great modern enterprise must have special courage, unusual foresight, and a knowledge of psychology and human conduct beyond mere book knowledge. The necessary co-ordination and co-operation of thousands of different individuals, all alien of end and of aim, so that their diversified talents and knowledge are harmoniously directed to accomplish a definite thing is no small task. Teamwork is what does it.

It is easy to get co-operation, but more difficult to get co-ordination. August Bruski had a wife and a bright boy of fourteen and an older daughter. The peace of the little family was almost wrecked over their willingness to co-operate and their failure to co-ordinate their efforts. The son won a place on the commencement program of his school. He knew his speech perfectly. The family was proud and happy until the night before the great day, when the family decided that the boy had no suitable clothes unless he could wear his father's trousers, which were six inches too long. The father wasn't willing to have the six inches cut off and the son was in tears at the thought of wearing them rolled up. However, it was decided, after long debate, that that was the best thing to do, and the family retired—but not to sleep. The mother shared the horror of her son at the thought of those rolled-up trousers and at last decided to get up and cut off the extra six inches, which she did. Meanwhile, the sister tossed and fretted in sympathy with her brother and finally she too decided to cut off the extra six inches in an effort to co-operate. So she got up and cut another six inches off the trousers. Co-operation without co-ordination will not make our pants fit.

Plato's Rules and Good Management

Good management is the rule of the best minds. Organizations controlled by management follow the rules laid down by Plato for the perfect society, namely, "the wisest have the most authority." It is antidemocratic, although private organizations flourish best in democratic countries. However, the democratic rule of the majority will frustrate and defeat any management. The crew cannot run the ship. It is popular to think that the majority is always right, but there is as much difference in feeling right and being right as there is in feeling good and being good.

A friend was crossing one of the many bridges which span the Allegheny River in downtown Pittsburgh, when he was stopped by two robbers who demanded his pocketbook. My friend protested. The robbers replied that they wanted only what was right and fair and would be willing to submit the matter to a vote of the three of them and let the majority decide. With all solemnity the vote was taken and the majority won and my friend lost his pocketbook.

Decisions in organizations under management are never made by weight of numbers. Every decision is made by those persons best qualified by knowledge to make it. Finally, all decisions of each qualified group or division are co-ordinated into the activity of the organization as a whole.

Management is impersonal. It must travel a narrow road. The twilight zone of human frailties and error, which bounds all our acts as individuals, is denied it. Management may be kind, but not sentimental; liberal, not extravagant; frugal, not stingy. Higher things are demanded of management than we require of ourselves.

The ordinary results of management—trains on time; complete machines, such as automobiles, that operate perfectly; a plentiful supply of daily food; all these illustrate better than anything else how far we have traveled from the disorganized, confused world of other days. Athens fought Sparta and both were ruined because they had no means of communication except on foot. The two cities were strangers. Today, London and Berlin are not strangers; neither are New York and Los Angeles. Due to modern means of communication these cities are in constant touch and the traveler can visit either with greater ease and comfort than a citizen of Sparta could go to Athens, 100 miles away.

In the States we speak of George Washington, our first president, as the father of our country. Our great progenitor was the father of a little country on the Atlantic seacoast. If the facilities of communication, to mention only one modern convenience, had remained as they were then, the United States of America as we know it could not have existed. The people of the Middle West would have been foreigners to the East, and the Pacific Coast would have been a separate empire beyond the Rockies—vague, mysterious, and unknown—visited only occasionally by a few courageous travelers who enjoyed hardship and danger. This inevitable condition was prevented because private enterprise furnished the telegraph and telephone for speech communication and the railroads for transportation of goods and persons. The grain of the great plains could find a market in the East. We developed a need for each other. It might well be that Alexander Bell, with his telephone, or George Westinghouse, with his air brake, might likewise be called fathers of our country. George Washington started it, but it could not have been developed to its present state without countless contributions from private organizations.

We are so accustomed to the luxuries and conveniences of our modern life that we no longer value them or view them as the miracles they were once thought to be. Everything is accepted as a matter of course. If we could look through the eyes of our forefathers we would see these everyday things differently. Let us ask an old forty-niner, who crossed the continent with an ox team averaging eight miles a day, to inspect and ride on the new "Super Chief" that leaves Chicago at 7:15 p.m. and 39 hours later rolls into Los Angeles. What he would feel and say would gladden the heart of every railroader and do much to restore his confidence in his profession.

Why not bring Columbus back to life and take him on a tour of inspection of the "Queen Mary?" No phrase fits his astonishment except to say he would not believe his eyes. "Such a monster could not float! And what could make it move? It has no sails." His astonishment and bewilderment would be complete if in less than 5 days he traveled over the very ocean which he so laboriously crossed in 70 days.

I cannot resist inviting Sir Isaac Newton, the great scientist, to tour our modern research laboratories, all a part of management's contribution to society. He would find that science had learned secrets of nature which would make even the law of gravitation commonplace. And in addition to learning the laws of nature we have also learned how to apply them in endless ways, not only for the glory of God as the old order said, but for the use and comfort of man himself.

Management of a private enterprise must not only produce goods and services, but must make a profit, or it fails. All managers know this and accept the responsibility of making profits as a spur to wise administration. Management knows it is on the fairway if its operations are in the black. Profit, or the lack of profit, is the one thing which insures efficiency in private enterprise as contrasted to an activity without the profit motive. But because of profits, management is charged with being greedy. It is easy for the "have nots" to cry, "Shame!" To be specific, it is alleged that too much money is earned in private enterprise and paid out to the owners or stockholders, and that managers themselves get too large a share in salaries and bonuses.

Let us examine the first charge, that private enterprise makes excessive profits. It is interesting to note that this charge is made now and not when the fortunes of the Vanderbilts, Carnegies, Harrimans, Astors, and Rockefellers were made. It is obvious that great profits have at times resulted from private enterprise, but the average net earnings of 200 major companies in America during the past ten years were less than six per cent on the investment. During that period, exceptional companies did make large profits, but other exceptional companies had great losses. The conspicuously successful company receives all our attention and the world carelessly assumes the exception proves the rule. When the public thinks of an automobile company it thinks of Ford, General Motors, Chrysler, and a few others that have been very successful, and forgets the scores of other companies such as Winton, Stutz, Mitchell, Peerless, and Mercedes, which not only did not make profits but actually failed with the loss of all on board.

Over any long period of time the failures in business practically equal the successes. Dun and Bradstreet reports that every day on an average of 1,292 new corporations are created, and 1,142 come to an end by one means or another. The record of management not only shows no exorbitant profits on the whole, but actually shows extreme and fatal losses, which in many cases might be laid directly to mismanagement. Management might properly be taken to task for making too little money, not too much. The profits are so small, as a rule, that I am surprised the stockholders do not form a union to demand a greater return. Perhaps they need only a John L. Lewis to arouse them. In any case, a lucrative reward awaits some enterprising person as president of the International Stockholders Protective Union. The ISPU might serve a useful purpose by presenting comprehensive demands for a greater share of the income of business to offset insistent demands of other groups. No, management is not guilty of exorbitant profits.

Turning for a moment to the charge of too-high salaries and bonuses, it is not easy to know what management should be paid. It is significant that high salaries are not paid for long to poor management because management must make its own salary and bonus. In America taxes reduce high salaries and bonuses very sharply. As one high-salaried man said: "The government is more interested in my salary than I am, as the government gets most of it."

What are the services of anyone worth? I assume that all other little girls nine years old would say that Shirley Temple is overpaid and that they would gladly take her place for much less.

It should be borne in mind that in this age management does not, as a rule, own the business it manages. It is hired by the owners to run the enterprise and is usually paid enough to keep it from going to some other organization or starting a competing business. Whether it is too much or too little would depend upon the circumstances, but I do know that the salaries of top management in the average company are less than one per cent of the payroll, and who would not pay this much for good management? For that one per cent of the payroll the enterprise is successful and the consumer gets the goods he wants, labor is employed, and the owners are recompensed.

The most recent charge against private enterprise is that it is responsible for unemployment because it hasn't work for all. Government says to industry, "You must employ more labor or else." It is about as foolish as though someone would tell each one of us, "Before you leave Washington you must buy an automobile and hire a chauffeur for a year and take both to your home and use them." And when we refuse to do so charge us with being responsible for unemployment. Generally speaking, the whole charge is grossly unfair. Private enterprise is engaged in providing goods and services for others in a highly competitive market. If the public or consumer wants the goods and services and buys them, then business has need for labor and can give employment, but unless it can sell its products first it cannot give employment. The perfect example of this is the electric service utility. Unless a customer (multiplied by thousands) presses a button or closes a switch the utility makes no sale and has no output, and no income. The utility, of course, cannot produce goods or services that its customers do not voluntarily accept. Other industries, whose products can be stored in the absence of consumer demand, are stopped just as definitely, however, by limits imposed by financial resources, by storage space, or by depreciation of the product. The confusion of thought on this simple point is amazing. It reminds one of the two inmates in the insane asylum who were engaged in driving, or trying to drive, a common nail into the wall of the room. The first man held the head of the nail against the wall and tried to drive it in, without result. He was heard to exclaim in disgust, "The darn fool's put the head on the wrong end." The other inmate said, "You ought to drive it in the opposite wall."

There is a general belief that management will not hire people over 45 years of age. This is pure myth. Well-established factories with which I am familiar have a higher percentage of their employees between the ages of 45 and 68 than the whole population of the United States has between these same ages. This is also true if you take for comparison ages 40 to 68, or 50 to 68. Every organization values its trained and dependable older men and, in times of depression, keeps them to the last. Competent older men always have whatever work there is. If any group has a just complaint it is the younger men, who are always discharged first.

It is true that the older man out of work has a harder time getting a job because industry always has a full crew of older men, as we have shown, and needs to hire younger men to get their point of view and to train them to be useful older men some day. Pitiful as the case of the older unemployed may be, it is tempered materially by the fact that he is preferred in the job when he has one.

Management has a great responsibility to furnish as regular and remunerative employment as it is possible to do. Under modern conditions, the average employee hopes and expects to work for a good organization all his life. He marries, buys a home, and makes commitments for the future, all based on his expectations of continuous employment. This is a perfectly natural thing to do, and management must recognize that it has the responsibility to meet the expectations of its employees, if at all possible. In the past, management has paid scant heed to the problem of furnishing yearly employment. It has expected labor to share the ups and downs of business. If times were bad labor was unemployed. In a degree, this cannot be avoided. But management, by careful planning, may be able to smooth out, to an appreciable extent, the ups and downs of labor. Management has been guilty of a day-to-day existence, which magnifies the plight of labor. If management holds out the hope of employment today, it must not shatter that hope tomorrow. Management should be able to plan its work so that improvements, major repairs, and expansion are done in periods of depression when labor might otherwise be unemployed. This means that private enterprise must have sufficient funds to carry it through depressions with confidence. Government must assist management in this laudable undertaking and should be interested in assisting it to maintain a sound financial condition rather than weakening it by unwise taxation.

The modern world is complicated beyond belief. No one, not even the simplest citizen, lives what might be called the simple life. None of us can truly take care of himself. We depend entirely upon other people for the necessities and luxuries of our lives. Light comes to us over a wire; heat through a pipe; water through another pipe. We are carried to and from our work in public conveyances. Food is to be found around the corner if we can get the necessary nickels to purchase it, and if we cannot, government has to furnish it or we perish. In such a world the need of management is imperative. The minute the mob takes over the power plant the city is in darkness. Order and system, which are possible only through management, must prevail throughout the modern world. The managers of today, imperfect men as they are, are still the pick of all the candidates available, and it is their responsibility to maintain the proper functioning of the vital necessities of our life. Management may not quit under criticism. It is not enough to stand up under criticism when one merits it, it is necessary to stand up and take it on the chin when one does not merit it. This is the law of good sportsmanship. It is also the law of good society, and management must measure up to it. If anyone is captain of our modern ship, management is, and it cannot desert its post.

The collateral responsibilities of management are many. Large factories and mass production lead to congested living conditions and the inevitable lowering of health and morals. Management is not directly responsible for the social conditions which are the indirect result of its factories and production methods, but it must nevertheless accept a fair share of the responsibility for these indirect results. The rise of material well-being, which is everywhere apparent, was attained only at a price. The innocent victims of these conditions are helpless. They are the weak and the unfortunate and in every age suffered ill health and have been poorly fed and poorly clad. But their condition, by proper attention, may be ameliorated and management must accept part of the responsibility for the amelioration. Just as it has long since accepted the responsibility of securing safe and healthful surroundings in which men work, it must now accept the responsibility of helping employees secure safe and healthful surroundings in which to live. Anything short of this is a neglect of clear responsibility.

Since we live in an almost wholly artificial world, there would seem to be no escape from providing artificial or man-made aids to health. Parks and playgrounds must be furnished and a reasonable amount of outdoor life provided. The comfort and health of every community must receive constant attention.

Finally, since management can exist only in an environment suitable to its needs, it must recognize its obligation to the society of which it is a part. In many cases society has decreed regulations and restrictions which hamper management and private enterprise, but society is the sole arbitrator of what it considers right, and management must conform. It has no choice. It is as helpless in the face of social restrictions as it is in the face of economic conditions. All management of private enterprise realizes that changing times affect business and may in time render it useless. The canal has gone. The horse and buggy has gone. The street railway and steam railroads are suffering from changed conditions, but management must accept these things and it must also accept proper governmental regulations.

And inasmuch as government is forced by the very nature of things to assume a larger and larger role in our everyday life, regulating more and more what we do and how we live, it needs the assistance of management more than the government of any other age. Management should willingly offer its talents and services to government because management is the only source from which government can get the necessary talent to operate its many activities efficiently. It now ignores management, and management scowls at government. They are both wrong. Meanwhile the people suffer. Modern government cannot exist without better management. Management must accept its responsibilities and offer its services to any good government that asks for them. Government has a proper field of regulation which management recognizes and accepts. It is equally true that management has a field of accomplishment which government now lacks and would do well to recognize.

Complexities of This Kilowatt-Hour Age

The affairs of man move along with surprising speed and power. We see trade and commerce going on uninterruptedly between individuals and between groups of individuals, with ships crossing every sea and stopping at every port. It is obvious that a well-ordered world is necessary for the growth of prosperity and that anything which interferes with the exchange of raw materials or the products of human labor tends to lower the standard of living, but it is not obvious that private enterprise is the mainspring of all our activities. The demagogue ignores private enterprise and considers it of no importance. The situation reminds me of my experience the other day in an airplane. I was sitting forward and looked out the window from time to time. Nothing but the wing obstructed my view. I could see the whole horizon and the ground below at an angle. I repeat, nothing obstructed my view; I could see clearly. I was alarmed when I realized that my view was directly across the end of the motor where there should be a propeller. But there was none. I mean I couldn't *see* one, and as far as my eyes were concerned there was no propeller. If I had not known that I couldn't see a fast-moving propeller, I might have assumed that airplanes move through the air by virtue of government regulations, or some mysterious power, without propellers. Sometimes I think we judge our civilization just as faultily. We see things moving along, goods being made, wages being paid, taxes being collected, human beings living and dying with a more or less steady rhythm, and we haven't any idea of what keeps things moving. We can't see the propellers of our civilization. The greater the speed of living, or the higher the standard of living, the less people comprehend it. Almost anyone can understand a horsepower civilization and the simple transactions which constitute its life. Grain is planted, harvested, and sold; simple goods are manufactured and purchased. The complete round of life is clearly visible. But who among us can get a glimpse of the mechanism of this kilowatt-hour age, which is propelled through space almost as fast as the electric current which symbolizes it? Propellers we cannot see may be overlooked and neglected.

Under such circumstances, when the wisest are at a loss, and it seems easier to be wrong than to be right, management must stand by its colors, struggling to maintain the cause of free enterprise in a world threatened with unwise regulation. Free enterprise may confidently hold up its head as representative of one of the most vital functions in our national economy today. It is the one thing which stands between us and a stale, flat, unhappy world of universal regimentation and individual conformity to a single pattern.

News
Of Institute and Related Activities

North Eastern District to Meet at Springfield

A three-day meeting and Student Branch convention of the AIEE North Eastern District will be held May 3–5, 1939, at Springfield, Mass., under the sponsorship of the Springfield Section. Headquarters will be at the Hotel Kimball, and arrangements have been made to house those attending in this hotel and in other hotels in the city.

Springfield, situated in the Connecticut River valley, is the center of a growing and prosperous industrial area, and is convenient for those traveling by automobile. Excellent transportation facilities are also available from all points to Springfield by either bus or railroad.

An attractive program of entertainment, sports, inspection trips, and technical sessions will be offered. According to present plans there will be four technical sessions, one general session, and two student sessions; the latter will run concurrently. Many high-grade papers are available for the technical sessions, which will be of interest to different groups of engineers, and there will be addresses of interest to all attending the general session. Present plans contemplate holding the two student sessions Friday morning, May 5.

A stag smoker will be held Wednesday evening, May 3, at the Highland Hotel. Plans are being made to provide interesting entertainment and a buffet luncheon will be served. An informal banquet will be held Thursday evening.

W. O. Henschke (A'32) present chairman of the Section, is general chairman of the committees on arrangements for the meeting, and F. R. Longley (A'25) is chairman of the meetings and papers committee.

Hoover Medal Awarded to J. F. Stevens

John Frank Stevens, 85-year-old civil engineer of Baltimore, Md., was presented with the third Hoover Medal during the recent meeting of the American Society of Civil Engineers in New York, N. Y., with the following citation:

> John Frank Stevens, engineer of great achievement as illustrated in his work on the Panama Canal, who, in his dealings with the Inter-Allied Forces in Siberia in the Great War, demonstrated those broader capacities for humanitarian public service beyond his calling, which have earned for him the recognition of the Hoover Medal for 1938.

Born in West Gardiner, Maine, April 24, 1853, Mr. Stevens, after serving as assistant engineer of the City of Minneapolis from 1874 to 1876, engaged in engineering service on railroads in the Northwest, until in 1905 he was appointed chief engineer of the Panama Canal, and later chairman of the Isthmian Canal Commission. From 1907 to 1909 he was vice-president in charge of operations of the New York, New Haven and Hartford Railroad, and later became president of several West Coast railroads. He went to Siberia in 1917 as chairman of the Commission of Railway Experts to assist the Russian Provisional Government in the reorganization and operation of its railways. Following the Armistice he remained in Manchuria and became president of the Inter-Allied Technical Board. In 1927 Mr. Stevens was elected president of the American Society of Civil Engineers, and he has been awarded the John Fritz Medal, the Gold Medal of the Franklin Institute, and other honors.

The Hoover Medal was formally instituted in 1930, to commemorate the civic and humanitarian achievements of Herbert Hoover (HM'29) to whom the first award was made. The second award was made to the late Ambrose Swasey in 1936. The board of Award consists of representatives of the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, and the AIEE. Present chairman of the board of award is Gano Dunn (A'91, F'12) president of the J. G. White Engineering Corporation, New York, N. Y., and AIEE past-president.

Alfred Noble Prize for 1938 Awarded

Announcement has been made of the selection of Ralph J. Schilthuis as winner of the Alfred Noble Prize for 1938 for his paper, "Connate Water in Oil and Gas Sands," published in the 1938 issue of *Petroleum Technology*. Mr. Schilthuis, who is in the production research department of the Humble Oil and Refining Company, Houston, Texas, will receive the prize at the annual dinner in February 1939 of the American Institute of Mining and Metallurgical Engineers, of which he is a member. He has been employed by the Humble company since his graduation in 1930 from the Colorado School of Mines.

The recipient of the Alfred Noble Prize is selected by a committee of five, consisting of one representative from each of the four Founder Societies and the Western Society of Engineers. The prize was instituted in 1929 in honor of Alfred Noble, past-president of the American Society of Civil Engineers and of the Western Society of Engineers, and consists of a $500 cash award and an engraved certificate. The award is made to a member of one of the societies represented for a technical paper of particular merit accepted by the publication committee of any of the societies for publication in whole or in abstract in any of their respective publications, provided the author is not over 30 years of age at the time of acceptance of the paper in practically its final form. The award now is made for papers presented during the 12 months preceding June 1 of each year. The present award is the sixth, the first having been made in 1931; three have gone to members of the AIEE.

This year, for the first time since the establishment of the prize, an honorable mention was given. This went to E. C. Huge of Barberton, Ohio, for his paper entitled "Experimental Investigation of Effects of Equipment Size on Convection Heat Transfer and Flow Resistance in Cross Flow of Gases Over Tube Banks." Mr. Huge is a member of The American Society of Mechanical Engineers.

D. W. Mead to Receive 1939 Washington Award

Daniel Webster Mead (A '11, F '13) has been elected to receive the Washington Award for 1939 "for his superior contribution to sound theory, good practice, and high ethical standards in the creation of engineering works as an engineer and as a teacher," according to an announcement by the Washington Award Commission. Doctor Mead is a consulting engineer and professor emeritus of hydraulic and sanitary engineering at the University of Wisconsin, Madison. A biographical sketch of Doctor Mead may be found in the "Personal Items" section of this issue.

Presentation of the award will be made at a dinner meeting of the four Founder Societies and the Western Society of Engineers to be held in Chicago, Ill., February

Future AIEE Meetings

South West District Meeting
Houston, Texas, April 17–19, 1939

North Eastern District Meeting
Springfield, Mass., May 3–5, 1939

Summer and Pacific Coast Convention (combined)
San Francisco, Calif., June 26–30, 1939

Great Lakes District Meeting
Minneapolis, Minn., September 27–29, 1939

Middle Eastern District Meeting
Scranton, Pa., October 11–13, 1939

20, 1939. The award, consisting of an inscribed bronze plaque mounted upon a marble base, is given annually, when deserving candidates are found, by the award commission as "an honor conferred upon a brother engineer by his fellow engineers on account of accomplishment which pre-eminently promote the happiness, comfort, and well being of humanity." The commission is composed of 18 members, representing the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, AIEE, and Western Society of Engineers.

The award was founded in 1916 as the outgrowth of an endowment and suggestion by John Watson Alvord of Chicago that there should be some means of recognizing outstanding engineers who render pre-eminent service in promoting of public welfare. The idea was proposed originally to the Western Society of Engineers, which invited participation of the other societies.

Recognized as one of the highest honors that can be conferred upon an American engineer, the first award was made in 1919. Doctor Mead is the eighth member of the AIEE to receive this honor.

Subway Builder Dies. Robert Ridgway, consulting engineer, died at Fort Wayne, Ind., on December 19, 1938. Born in Brooklyn, N. Y., in 1862, Mr. Ridgway was engaged first in work on the location and construction of the aqueduct, dams, and reservoirs of the Croton system supplying New York City with water. From 1900 to 1905 he was engaged in the construction of New York subways, then returned to water supply as division engineer on construction of the Catskill system until 1912, when he again took up subway work. In 1921 he was appointed chief engineer of the Transit Commission, and when the Board of Transportation was established in 1924 to build the Independent Subway System, he was made chief engineer. In 1932 he was appointed consulting engineer, and retired the following year. Mr. Ridgway served frequently on studies of the Chicago subway problem, Boulder Canyon project, San Francisco bridge, New York vehicle tunnels, and on numerous other consulting boards. He was president of the American Society of Civil Engineers in 1925 and was elected to honorary membership in 1934.

South West District to Meet in Houston

A three-day meeting of the AIEE South West District will be held in Houston, Texas, April 17–19, 1939. Arrangements are being made for an interesting program of technical sessions, entertainment, and trips to places of interest in the vicinity.

Tentative arrangements for technical papers indicate that the subjects of general circuit theory, communication, power generation, pipe-line corrosion, rural-line performance, and supervisory control will be included in the program.

The personnel of the South West District meeting committee, which is making the arrangements for the meeting, is as follows: F. C. Bolton, *chairman;* L. T. Blaisdell, V. O. Clements, H. C. Dillingham, and Seth Evans. The chairman of the subcommittees are: N. F. Rode, meetings and papers; H. P. Haefer, entertainment; J. B. Arthur, attendance and publicity; L. Del Homme, transportation and inspections; H. F. Staacke, hotels and registration; and E. M. Wise, finance.

To Student Members Who Have Now Graduated:

The Institute membership welcomes you to the Associate grade and wishes you good luck and success in your chosen profession.

National Membership Committee

Columbia University Offers EE Scholarship

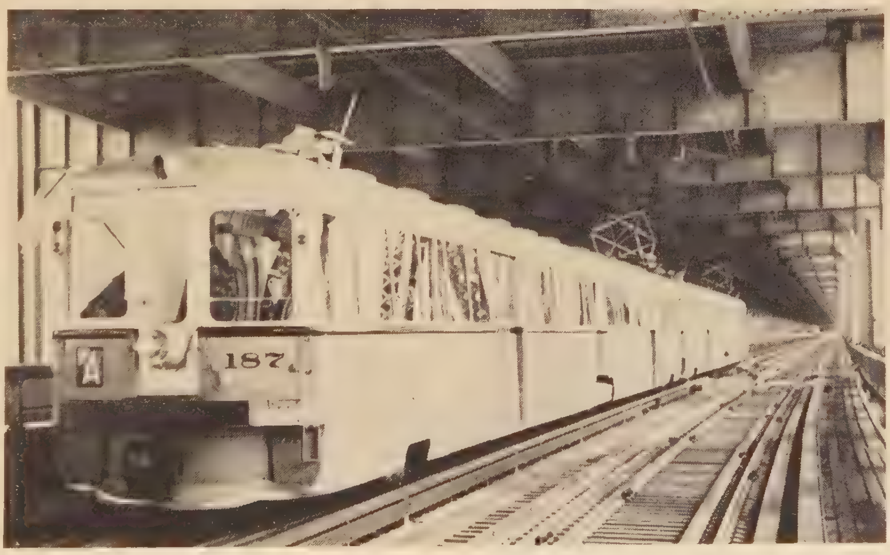
The governing bodies of Columbia University have placed at the disposal of the AIEE each year a scholarship in electrical engineering in the school of engineering of Columbia University for each class. The scholarship pays the annual tuition fees of $380. Reappointment of the student to the scholarship for the completion of his course is conditioned upon the maintenance of a good standing in his work.

To be eligible for the scholarship, the candidate recommended will have to meet the regular admission requirements, in regard to which full information will be sent without charge upon application to the secretary of the University or to the national secretary of the Institute.

In a letter addressed to the national secretary of the Institute, an applicant for this scholarship should set forth his qualifications (age, place of birth, education, reference to any other activities, such as athletics or working way through college, references, and photograph). A committee composed of W. I. Slichter, *chairman,* Francis Blossom, and H. C. Carpenter will consider the applications and will notify the authorities of Columbia University of their selection of a candidate. The last day for filing of applications for the year 1938–39 will be June 1, 1939.

The course at the Columbia school of engineering is a graduate course which may be either elective leading to the degree of master of science or prescribed leading to the degree of electrical engineer. For the former, requirement for admission is the completion of a four-year course in electrical engineering as evidenced by a bachelor's degree from an approved institution. For the professional degree, the requirements are more specific as to course content and include a considerable proficiency in mathematics, physics, and chemistry, and some

San Francisco Bay Bridge a Convention Attraction



ELECTRIFICATION of the San Francisco-Oakland Bay Bridge railway, involving different voltages, offered many engineering problems in its design and construction. The project will be one of the high spots to be seen during the combined AIEE summer and Pacific Coast convention at San Francisco, Cal., June 26–30, 1939. As electrical engineers on the Pacific Coast are particularly concerned with the utilization and maintenance of electrical equipment, a well-rounded program of particular appeal to the engineer in industrial and commercial fields is under preparation.

knowledge of the humanities, as well as the usual undergraduate technical courses. The candidate is admitted on the basis of his previous collegiate record without undergoing special examinations. Other qualifications being equal, members of the Student Branches of the AIEE will be given preference.

The purpose of this advanced course is to produce a high type of engineer, trained in the humanities as well as in the fundamentals of his profession. It is hoped that Enrolled Students and others qualified will show a keen interest in this scholarship.

Winter Convention to Be Reported in March Issue

As this issue goes to press, the Institute's 1939 winter convention is under way at New York. Attendance at technical sessions and social events of this five-day meeting indicates that it continues the successful record of winter conventions. Registration for the first two days totaled 1,159 compared with 1,027 for the first two days of the 1938 convention, 827 for 1937, and 1,046 for 1936.

Presentation of the John Fritz and Edison Medals was made on the evening of January 25 to F. B. Jewett (A'03, F'12) and D. C. Jackson (A'87, F'12), respectively. An article by J. W. Barker (M'26, F'30) outlining the accomplishments of Doctor Jackson is published on pages 64–6 of this issue. A report of the convention and its special events is scheduled for inclusion in the March issue.

Future Meetings of Other Societies

American Chemical Society. Annual spring meeting, April 3–7, 1939, Baltimore, Md.

American Institute of Chemical Engineers. 31st semiannual meeting, May 15–17, 1939, Akron, Ohio.

American Institute of Mining and Metallurgical Engineers. Annual meeting, February 13–16, New York, N. Y.
Open-hearth conference, April 26–28, Cleveland, Ohio.

American Physical Society. 226th meeting, February 23–25, 1939, New York, N. Y.
227th meeting, April 27–29, 1939, Washington, D. C.

American Society for Testing Materials. Committee week and regional meeting, March 6–10, 1939, Columbus, Ohio.

American Society of Civil Engineers. Spring meeting, April 19–22, 1939, Chattanooga, Tenn.

American Society of Mechanical Engineers. Spring meeting, February 23–25, 1939, New Orleans, La.

Machine and Tool Progress Exhibition, March 14–18, 1939, Detroit, Mich.

American Society of Refrigerating Engineers. Spring meeting, May 21–22, 1939, Hershey, Pa.

Association of Iron and Steel Engineers. Annual spring conference, March 27–28, 1939, Birmingham, Ala.

Canadian Institute of Mining and Metallurgy. Annual meeting, March 13–15, 1939, Hotel Frontenac, Quebec, Can.

René Thury Dead. The inventor of an early system of high-voltage d-c power transmission, Doctor René Thury, died recently in Switzerland at the age of 78. A native of Geneva, he was one of the pioneers in the design of electrical machinery and in railway electrification. In 1889 he devised a system for d-c transmission using several generators connected in series at the transmitting end to supply a number of motors, also connected in series, in one or more substations at the receiving end of the line. The current transmitted was kept constant by inserting or short-circuiting one or more machines, so as to alter the voltage. He also developed a sensitive voltage regulator for use with the system. Doctor Thury was elected an honorary member of the Institution of Electrical Engineers in 1934.

Current Items From American Engineering Council

National Patent Inquiry

A factual inquiry into the American patent system has been undertaken by American Engineering Council at the invitation of the National Industrial Conference Board. The inquiry is to be conducted by a separate special staff employed under direction of the patent committee of AEC, and financed from funds provided by the NICB outside the present income of AEC. Announcement of the plan was made by the conference board in the following statement:

> A comprehensive investigation of the whole patent problem has just been started by the National Industrial Conference Board, independent fact-finding organization of management and labor. Technical phases of the investigation will be supervised by the committee on patents of the American Engineering Council, while the economic aspects will be analyzed by the conference board's economists under supervision of Doctor Robert F. Martin, director of the economic research division of the board. Much work on the patent situation has already been done by the AEC committee under the chairmanship of R. S. McBride, consulting chemical engineer. The other members of the committee are James H. Critchett, general manager, Union Carbide and Carbon Research Laboratories, Inc.; William M. Grosvenor, consulting chemist and factory engineer; Frank B. Jewett, president, Bell Telephone Laboratories, Inc.; Warner Seely, secretary, Warner and Swasey Company; and Kenneth H. Condit, executive assistant to the president, National Industrial Conference Board. Close co-operation with other organizations concerned with this problem is assured through representation on their patent committees by members of the board's staff.
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> Every phase of the patent problem will be studied by the experts of the conference board and engineering council. Five main headings are included in the outline of the inquiry. Under the general topic "Invention," there will be a study of the origins of inventions and a review of independent and organized invention. Such matters as costs, types of invention, work on inventions, use of patents, and foreign experience will also be covered.
>
> Perhaps the most important subject of the five concerns the social and economic effects of invention. Under this heading the effects on consumers, labor, capital, and management will be studied in detail.
>
> A third heading covers an examination of the patent system itself and the functioning of the Patent Office. Consequences of the patent system as shown by stimulation of invention and discovery are covered in another section. The final heading includes a critical review of the functioning of the patent system, and of current criticisms and proposed reform.

This co-operative undertaking makes possible the fulfillment of recommendations made for such a fact-finding study earlier presented by the patents committee of AEC to the annual assembly in 1937 and 1938, and approved by that body. The patents committee at a recent meeting approved of a detail plan of procedure and one division of the work has already been started. It is hoped that the complete undertaking will be finished within 12 months and that factual sections of the inquiry can be released before that time.

Nineteenth Annual Meeting Held in Washington, D. C.

Representatives of the member engineering organizations of American Engineering Council met in Washington, D. C., January 13–15, 1939, for the nineteenth annual assembly of AEC. The program included meetings of Council's principal committees, election of officers, and the annual "All Engineers' Dinner," at which Doctor Vannevar Bush (A'15, F'24) president of the Carnegie Institution of Washington, was guest speaker. The ninth annual conference of engineering societies' secretaries, devoted to discussion of the responsibilities of the organization secretary, was held concurrently.

Report of Executive Secretary

In his annual report to the assembly, Executive Secretary F. M. Feiker (M'34) summarized the work of AEC committees and staff. His report was divided according to the five objectives of Council's plans for the year, namely: public affairs function, public discussion function, engineers' embassy function, publicity function, and fact-finding function. Many of the activities have been reported from month to month in Electrical Engineering.

Present officers whose terms expired were re-elected at the annual business session. AIEE representatives present were: C. O. Bickelhaupt (M'22, F'28), W. H. Harrison (A'20, F'31), C. R. Jones (A'16, M'30), John C. Parker (A'04, F'12, president), and National Secretary H. H. Henline (A'19, M'26). AEC officers for 1939, in addition to Mr. Feiker, are: *President*—William McClellan (A'04, F'12); *Vice-Presidents*—Mr. Bickelhaupt, R. E. Flandens, J. S. Dodds, and A. J. Hammond; *Treasurer*—L. J. Fletcher.

Letters to the Editor

CONTRIBUTIONS to these columns are invited from Institute members and subscribers. They should be concise and may deal with technical papers, articles published in previous issues, or other subjects of some general interest and professional importance. ELECTRICAL ENGINEERING will endeavor to publish as many letters as possible, but of necessity reserves the right to publish them in whole or in part, or reject them entirely.

ALL letters submitted for consideration should be the original typewritten copy, double spaced. Any illustrations submitted should be in duplicate, one copy to be an inked drawing but without lettering, and the other to be lettered. Captions should be furnished for all illustrations.

STATEMENTS in these letters are expressly understood to be made by the writers; publication here in no wise constitutes endorsement or recognition by the American Institute of Electrical Engineers.

The Paradox of Social Progress

To the Editor:

Planned education as a means for keeping a proper balance between unrestricted technological progress and social progress is fundamental. It is so fundamental that the uninitiated might take for granted that today it was a part of an established program for national development. The fact remains, however, that "planned education" as it exists today is an unco-ordinated activity carried on by many groups for various purposes and is extremely lacking in effectiveness from a national point of view. Education is not alone in this respect. In many other fields that bear directly on the welfare and happiness of our people we find the same ineffectiveness. The reason, I believe, lies in the nature of our government. In our democracy, the individual—the village—the city—the state—and the federal government still jealously maintain their own concepts of sovereign rights. The small school district in many states can still control the extent and quality of its children's education. Furthermore, it will resent any efforts of higher authority to establish standards and controls.

Planned education must be a comprehensive program—national in scope and inclusive of all education from the kindergarten through the university. The majority of discussions on education appearing in the engineering journals deal only with the changes that can be made in college courses to effect a broader and more socialized education. It is true that many beneficial changes can be made in the college curricula, but the needs for a planned education call for more than this minor adjustment. The deficiencies in our over-all educational program that can be mitigated by curricula changes in the higher institutions of learning should receive immediate attention. Such changes, however, should be considered only as an expediency.

The over-all planning of education is, to my mind, the only reasonable approach. As I see it, the task is tremendous. It would require the co-ordinated activity of all the major educational groups in the nation; it would require extensive research to test theory; and, above all, it would require the unstinting devotion of time and energy of men and women whose vision extends beyond the horizon of personal glory. The difficulties of such a program are many. The co-ordination of the entire activity and the establishment of a common goal would be problems enough to try the courage of the strongest souls. Beyond this, however, lie even greater difficulties in the inertia of the masses that reacts so slowly to educational changes, and in the desire of unqualified politicians to become partners of such a program in other than legislative capacities.

What the program for a planned education should be, I can only suggest. Perhaps I should not dare even to make a suggestion in this field, for as an engineer my background in educational matters has been gained only through my exposure to a standard American education, through a very limited participation in school administrative activities, and through general reading. Nevertheless, I will tread where angels might not dare.

The fundamentals that I believe should be included in a program for planned education are expressed in the following generalities:

Through the medium of a national board delegated to formulate standards and policies for all educational institutions and to direct and co-ordinate research, the following changes in the educational field should be made:

1. All teachers should be required to have, as a minimum education, a four-year college course that would thoroughly prepare them for the specialized fields they wish to enter.

2. The kindergarten should be made a part of our compulsory education, with an entrance age of four years. Teaching at this age should be based on a play educational program of such nature that when a child reached the age of six years he would be able to read, would have a knowledge of simple arithmetic, and would be able to adapt himself to group activity.

3. The elementary-school curriculum should then be adjusted so that the first year or year and a half of our present high-school subjects are covered in the first eight grades. This readjustment should be carried through the high schools, so that the university could gain the equivalent of two additional years for the many essential courses that now are omitted or only partially covered.

4. In the engineering schools the teaching of manual arts should be eliminated, or at least the time devoted to them should be materially reduced.

Very truly yours,
C. M. Gross (A'27)

(Supervising Planning Engineer, Commonwealth Edison Company, Chicago, Ill.)

To the Editor:

Trusting that I may add to the fire kindled by Doctor George E. Hale in 1908, to which so much fuel has been added by Doctor Doherty's article, I submit the following discussion.

Doctor Doherty's concern about the chaotic state of today's world affairs is fully in accord with that of all who take time to think about what we are doing and where we are going.

Doherty sees only one way out—education. In that we agree, for certainly we can solve our problems if we but will to do so and study ways and means for accomplishing what we will.

When we acknowledge education as the way, we automatically close the doors to all thoughts of instantaneous utopias via the "Aladdin lamp route"—for education is ever a slow and sometimes a painful process involving great labor and sacrifice.

Scientists and engineers in their conquest against the physical burdens of man have achieved astounding success through the diligent application of brains, labor, and sacrifice.

This success, however, was not attained in the twinkling of an eye, but was accomplished inch by inch of a slow but constant shifting of the loads from the shoulders of men and the muscles of beasts to wood and water, then to coal and iron, and now to alloys and electricity.

Now we are learning that the world cannot be saved by science alone but must find a way to have all men learn the proper use of our mechanical gadgets as applied to the salvation rather than the destruction of civilization.

The engineering-education group is indeed fortunate when a man like Doctor Doherty, who after he has attained great success in the building of machines and factories and after becoming a powerful influence in industry, leaves industry and joins the educational group. In making this transfer he brings to our program of education a great knowledge of what colleges have taught and can tell us what has been useful and what has been ineffective in making college graduates efficient in the communities in which they live.

Out of this experience, he proposes a plan of education for engineers comprising for all a four-year program, one-fourth the time of which shall be devoted to a study of the humanities. For certain select men who show proficiency in the sciences and mathematics, he recommends graduate and research work carried on in conjunction with faculty members and with as close a relationship as possible to undergraduate students in order that the latter may profit by this contact.

This suggested program is indeed to me doubly interesting, because it is identically the program proposed just 30 years ago by the late Doctor George E. Hale, who, in contrast to the experience of Doctor Doherty, was an astronomer and idealist of great renown without any experience in the so-called industrial or practical affairs of the world.

Doctor Hale put his ideas about technical education into operation by becoming a member of the board of trustees of California Institute of Technology, formerly Throop Polytechnic Institute, and prescribing for it exactly the program now proposed by Doctor Doherty as one which should be carried on by a number of educational institutions, because as he says "effective public understanding cannot be realized by a mere handful of educated men; large numbers of them are necessary."

The success of California Institute of Technology in conducting for 30 years a program of technical education comprising four-year undergraduate courses with a large cultural subject content, all closely related to each other and to graduate courses, abundant in research, carried on by graduate students and faculty members is a monument to this program of education. This program, also wholly free from unfortunate departmentalism, has paved the way for the wider adoption of such programs as advocated by Doctor Doherty. Indeed, this is the method of scientific approach—first a single trial by a small group, followed by a more general adoption.

I would like to supplement Doctor Doherty's plan for the new engineering curricula by calling attention to the fact that I think his criticism of certain humanity courses which have been given in engineering curricula and found wanting, have been deficient more because of failure to place in charge of those courses teachers selected with the same care as has been exercised in the selection of teachers for the technical subjects. Furthermore the names of the courses and the particular content thereof are secondary in value—the value thereof being determined almost entirely by the personality, ideals, and character of the teacher. All specifications for all teachers in engineering colleges should include a demand for ideals of spiritual and moral integrity so strong as to make every faculty member an example and teacher of those characteristics as well as a teacher of the subject matter inherent in his courses. Surely men from Mars or any other planet outside this earth must be amazed by the dumb actions of a people who with more than enough for everyone are unable to distribute and use intelligently the bounties that nature and industry have provided. I trust that every engineer will read Doctor Doherty's paper and rally to his support by becoming acquainted with the details of what is the trouble with world affairs and showing those not technically trained that sacrifice of personal gain is the only key that will open the way out.

Sincerely yours,
R. W. SORENSEN (A'07, F'19)

(Professor of Electrical Engineering, California Institute of Technology, Pasadena)

To the Editor:

The address by Doctor Doherty on "The Paradox of Social Progress" published in the November 1938 issue of ELECTRICAL ENGINEERING, pages 444–8, is most interesting.

Doctor Doherty calls for research by social scientists and speaks of the specific studies that have been made on labor relationships, racial relations, social security, etc. To my mind the most important research that has to be made today is on the co-ordination between science and religion. It seems to me that science is not fulfilling its responsibilities if it does not use as its basis the concept that men are creatures made up of certain spiritual as well as physical characteristics; the higher the type of the individual, the greater being that proportion of his personality that might be called his higher or spiritual self. The physical nature of man has not changed to any great extent since the beginning of recorded history, but there has been much improvement in his spiritual self, especially since the civilizations of Asia Minor and Greece.

Certainly all scientists know that feelings such as those of kindness, altruism, and patriotism, are distinct from the physical feelings of pain or hunger, or the lusts of primitive men. Also that as the control of the mind and the will over the physical instincts and emotions becomes greater, mankind becomes more cultured, civilized, and socially conscious.

As an illustration of how well-known publicists have this same thing in mind, I take the liberty of quoting from a recent article by Walter Lippman. He says:

> There has been no difference of opinion among the great teachers of the western world that there is in human nature a disposition to evil, that government is not government which cannot restrain it, and that religion is satanic that does not seek incessantly to overcome it. Long ago Plato fixed the image of man's moral problem as that of a charioteer who drives a pair of winged horses: "one of them is noble and of noble breed, the other is ignoble and of ignoble breed." And living as he did in an age of disaster and disorder, Plato added that "the driving of them of necessity gives a great deal of trouble to the charioteer.
>
> He perhaps had seen what we have seen, the use of civil authority to arouse the disposition to kill, to maim, to plunder, rather than to subdue and control these lusts. For he too lived in an age of revolution, and this is the very essence of revolution. For whatever the outward and temporary appearances of order and even of splendor, the certain sign that a people is in the grip of revolution is that government and what passes for the official religion surrender to, cultivate, and then use for their own purposes the slumbering barbarian in man's nature.

Of course, it is evident that Doctor Doherty is not at all unaware of this and there must be complete agreement to his suggestion of a planned education to properly cultivate "social understanding and human appreciation," but scientists should insist upon the great importance of this education, even to the extent of holding that without it, scientific training is of no permanent value. "Social understanding and human appreciation" should be spoken of as religious qualities, to which mankind must be passionately devoted.

Only when such devotion becomes general can mankind be definitely on its way to rise consciously above its primitive instincts and lusts.

It would seem that since our forefathers definitely separated the church from the state, certainly a decision from which no one can differ, it is difficult to have the training of our youth in these spiritual things in the hands of the state. Supposedly it is in the hands of our religious organizations. Unfortunately, however, most religious teaching is based on mysticism and on supposed revelations from on high. The teachings of science, especially since the universal acceptance of the theory of evolution and the survival of the fittest, have led to the breakdown of the religious faith of the average man, perhaps in many cases subconsciously. Consequently, what scientists should try to do, it seems to me, is to teach that "social understanding and human appreciation" is the only true scientific basis for a modern religion, in a world dominated by a continuously increasing scientific understanding of the laws, both physical and spiritual, which govern our actions.

Scientists seem to be afraid to interfere with what are supposed to be the prerogatives of religious leaders, but science is inevitably wedded to morals and religion. It would appear that by frankly stating and passionately believing that "social understanding and human appreciation" must be the basis of life, and the basis of our religion, we will be in a better position to solve the problems of our highly complicated modern life—"to achieve intelligent control of the forces that shape social progress."

Yours truly,
GUSTAVO LOBO (A'01, F'12)

(President, Kelvin Engineering Company, Inc., New York, N. Y.)

Personal Items

D. W. Mead (A'11, F'13) has been elected to receive the Washington Award for 1939. Details of the award are given elsewhere in the news section of this issue. Doctor Mead was born at Fulton, N. Y., March 6, 1862, and received the degree of bachelor of civil engineering from Cornell University in 1884. During the period 1885–87 he was city engineer of Rockford, Ill., and engineer for the Rockford Water Power Company. He was occupied as a contractor from 1887 until he established a consulting engineering practice at Chicago, Ill., in 1900. In 1904 the University of Wisconsin appointed him professor of hydraulic and sanitary engineering. He continued in his private practice at Madison, however, and was a member of the engineering board sent to China in 1914 by the American Red Cross and the Chinese Republic to study the problem of flood control on the Huai River. He was consulting engineer for the Miami Conservancy District (Ohio) during the planning and construction of the flood protection works in 1915, a member of the committee that investigated the 1927 Mississippi floods for the National Chamber of Commerce, and a member of the Colorado River Board appointed under joint resolution of Congress to pass upon the plans for the Boulder Canyon project. He is now chairman of the board that represents the federal government in

D. W. MEAD

L. W. W. MORROW

F. R. INNES

D. G. EVANS

the Chicago Sanitary District's present construction work. The University of Wisconsin conferred upon him the honorary degree of doctor of laws at the time of his retirement in 1931. He is a member of the firm of Mead and Seastone, with offices at Madison, and the New York firm of Mead and Scheidenhelm. Doctor Mead is the author of several books on hydraulics. In 1936 he was elected president of the American Society of Civil Engineers, of which he is an honorary member, and was awarded the society's Norman Medal. He is also a member of the American Institute of Consulting Engineers, The American Society of Mechanical Engineers, American Water Works Association, Western Society of Engineers, Tau Beta Pi, Sigma Xi, and many other organizations.

L. W. W. Morrow (A'13, F'25) has just been made western editorial director of McGraw-Hill publications with offices in Chicago, Ill. He will have general direction of editorial activities in the Middle West for the several McGraw-Hill papers. As an educator Mr. Morrow served Cornell, Yale, and Oklahoma universities in their engineering departments. In the publishing field he has contributed to the technical press over a long period of years and from 1922 to 1936 was connected with the editorial staff of *Electrical World*. Mr. Morrow was also frequently engaged as an engineering consultant on various projects and in November 1936, resigned as editor of *Electrical World* to become general manager of the fiber glass division of the Corning Glass Works, Corning, N. Y. He is a past chairman of the New York section of the AIEE (1927–28), a past director (1933–37), and has served the Institute on many committees during a period of nearly 20 years. At present he is a member of the technical program committee, the committee on planning and co-ordination, the membership committee, the Thomas Alva Edison foundation, and the engineers' council for professional development. He is chairman of both the Edison medal committee and the committee on constitution and by-laws.

F. R. Innes (A'25, M'26) has been made chief managing editor of *Electrical World* with headquarters at New York, N. Y. Mr. Innes was born at Port Huron, Mich., October 11, 1889, and started work with the Port Huron Light and Power Company. From 1913 to 1923 Mr. Innes was with the Detroit Edison Company, serving in various capacities from meter inspector to assistant distribution engineer. In 1920 he was assistant editor of the employee's magazine of that company. In 1923 he went to Longview, Wash., to be in charge of design, purchase of material, and installation of mill and yard lighting for Sessions Engineering Company. The next year he was transferred to Portland, Ore., by that company. During this period Mr. Innes began contributing articles to technical publications, and in 1925 he came to New York as assistant editor of *Electrical World*. Since 1927 he has been western editor of that publication, with headquarters in Chicago. He was chairman of the Chicago Section of AIEE in 1931–32. During the World War Mr. Innes served with the medical corps and later with the engineers corps of the United States Army. He has been granted patents in connection with meter and switchboard work.

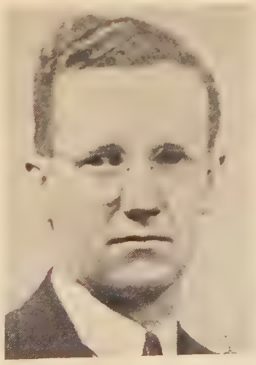
D. G. Evans (A'20) recently became vice-president of the Wisconsin Gas and Electric Company, Kenosha. A biographical sketch announcing his appointment appeared in the January 1939 issue, page 53.

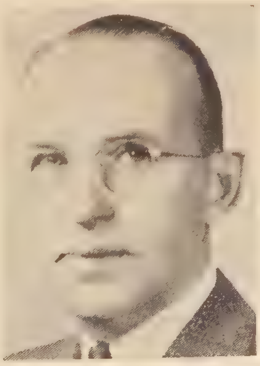
J. A. Tyvand (M'37) has been made chief engineer with supervision of all activities of the engineering department of the Wisconsin Gas and Electric Company at Racine, Wis. A native (1900) of North Dakota, Mr. Tyvand served with the United States Marine Corps during the World War. Following his graduation from the University of Minnesota in 1924, he went with the Milwaukee Electric Railway and Light Company as a junior engineer, but in 1929 left that company, where he was then starting engineer, to become system engineer for the Wisconsin Gas and Electric Company. In December 1936, he became electrical engineer for the Iowa Farm Bureau Federation at Des Moines, but returned to the Wisconsin Gas and Electric Company the following year as electrical engineer.

E. W. Seeger (A'16, F '36) has been made chief engineer of Cutler-Hammer, Inc., Milwaukee, Wis. Since his graduation from Ohio State University in 1913, Mr. Seeger has been with Cutler-Hammer serving in different capacities in shop and engineering departments. From 1928 until his recent promotion he was assistant chief engineer. Mr. Seeger has been granted many patents on electric-motor-control inventions. He has written many articles for publication in technical magazines and also a textbook on electromagnets. He was chairman of the Milwaukee Section of AIEE in 1929 and is a member of the codes and standards committee of the National Electrical Manufacturers' Association.

A. S. Moody (A'09) has been appointed commercial vice-president of the General Electric Company. Mr. Moody, a graduate of the University of California in 1906 with the degree of bachelor of science in electrical engineering, went with General Electric in 1907. He spent two years in the San Francisco, Calif., and Seattle, Wash., offices and then went to Portland, Ore., in 1910 as manager of the supply department of that office. For one year he was vice-president of the Pacific States Electric Company but returned to the General Electric Company in 1917 as assistant manager of the Portland office. In 1923 he was made manager of the Los Angeles office and in 1924 manager of the Northwestern territory with headquarters at Portland.

G. R. Shuck (A'19, M'20) has been made professor of electrical engineering at the University of Washington, Seattle. Professor Shuck was graduated from the University of Minnesota in 1906, spent a year as construction foreman with the Missouri River Power Company at Helena, Mont., and then a year in the research department of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. From 1909 to 1914 he was in the service department of the Westinghouse company at Seattle. He designed and supervised construction work with the Olympic Power Company of Port Angeles, Wash., for a year and then went to Kitchikan, Alaska, as superintendent of The Citizens' Light,


J. A. TYVAND


E. W. SEEGER

A. S. MOODY

Power and Water Company. For one year he was in charge of the electrical shops of the Polytechnic School in San Francisco and conducted classes in alternating currents for the University of California. He came to the University of Washington in 1918 as an instructor of electrical engineering and until recently had been an associate professor in his department.

C. L. Proctor (A'08) has been elected a director of Cities Service Power and Light Company. He now is vice-president and general manager of the Toledo Edison Company, Toledo, Ohio. A native of Virginia, he was graduated from Virginia Polytechnic Institute in 1902 and was awarded the degree of master of engineering there in 1903. From 1903 to 1908 Mr. Proctor was with the General Electric Company, Schenectady, N. Y.; from 1908 to 1915, general superintendent and purchasing agent for the Athens Railway and Electric Company, Athens, Ga.; and from 1916 to 1918 with the Empire District Electric Company, Joplin, Mo. From 1918 to 1919 he was vice-president and general manager of the Danbury and Bethel Gas and Electric Light Company, Danbury, Conn., but he returned in 1919 to become general manager of the Empire District Electric Company. In 1925 he left his position of vice-president and general manager of that company to accept a similar one with Toledo Edison.

H. R. Searing (A'20, F'30) has been appointed engineer of operation with the Consolidated Edison Company of New York, Inc., New York, N. Y. He had been serving as assistant engineer of that division, which is responsible for production, for system operation of generating plants and stations, and for all distribution operation, including apparatus, services, meters, and consumers' emergency services. Mr. Searing received his degree in electrical engineering from Cooper Union in 1916. Except for about three years, during which period he served as lieutenant and radio engineer with the United States Army, he had been with United Light and Power Company from 1913 until it became a part of the Consolidated Edison Company. Mr. Searing is credited with improvements to network devices and was closely associated with the development of the a-c network. He has served on several Institute committees.

J. J. Adams (A'36) is now working for the Zenith Radio Corporation, Chicago, Ill. Mr. Adams was graduated from the University of Colorado in 1934 and was granted his master of science degree in electrical engineering there in 1935. He formerly was engineer with the Philco Radio and Television Company at Philadelphia, Pa.

G. L. Knight (A'11, F'17) has been made engineer of construction and shops by the Consolidated Edison Company of New York, Inc., New York, N. Y., of which division he had been assistant engineer. Mr. Knight was graduated from the school of electrical engineering at Drexel Institute in 1900. Prior to his affiliation with the Brooklyn Edison Company in 1905, Mr. Knight did electrical work with the Philadelphia Electric Company, the United States Navy Yard, the Walker Electric Company, and the New York Edison Company. Mr. Knight is now vice-president of the Brooklyn Edison Company in addition to his position with the Consolidated Edison Company. Mr. Knight was vice-president of the AIEE (1926–28) and has served on many committees. He is currently serving on the AIEE Edison Medal committee.

L. B. Bonnett (A'18, M'25) has been appointed engineer of design and planning of the Consolidated Edison Company of New York, Inc., New York, N. Y., of which division he was made assistant engineer in 1938. Mr. Bonnett was graduated from Syracuse University in 1910 and was with the General Electric Company of Schenectady, N. Y., from 1910 to 1919. From 1919 to 1923 he was sales engineer with the General Electric Company, New York, N. Y., and then went with Brooklyn Edison Company. For the first three years he was inside plant engineer but became purchasing agent in 1926, which position he held until 1938.

H. L. Garver (A'25) has been made agricultural engineer with the Bureau of Agricultural Engineering, United States Department of Agriculture, Washington, D. C. Mr. Garver had been connected with the State College of Washington, Pullman, as rural electrification investigator for the past 13 years and is continuing this work with the Department of Agriculture. Following his graduation in electrical engineering from the State College of Washington in 1922 and prior to his return as rural electrification investigator, Mr. Garver was employed by the General Electric Company at Schenectady, N. Y. He is author and co-author of many bulletins and reports issued by the State College of Washington and of articles on agricultural engineering. He has been active in pest control and soil heating work with the American Society of Agricultural Engineers.

C. M. Hathaway (A'29) has established offices as a consulting engineer in Denver, Colo. A native of Paxton, Ill., Mr. Hathaway was graduated from the University of Colorado in 1927, was granted his master of science degree in 1928, and continued there as an instructor of electrical engineering for one year. Since 1929 he had been engineer with the General Electric Company at Schenectady, N. Y.

M. M. Rockwell (A'28, M'35) has been made electrical engineer in the production engineering department of the Lockheed Aircraft Corporation, Burbank, Calif. Mrs. Rockwell was graduated from the Massachusetts Institute of Technology in 1925 and received her degree in electrical engineering from Stanford University in 1926. From 1926 to 1928 she was employed in the testing department of the Southern California Edison Company and from 1928 to 1931 was technical assistant to the operating engineer. In 1931 Mrs. Rockwell was made assistant engineer of the Metropolitan Water District of Southern California. Since 1936 she has been a consulting engineer with offices in Los Angeles, Calif.

P. B. Harwood (M'36) has been made assistant chief engineer of Cutler-Hammer, Inc., Milwaukee, Wis. He has been employed by that company since his graduation from Carnegie Institute of Technology in 1917. Before the recent change Mr. Harwood was successively supervisor of the steel mill control division and then general engineering supervisor. Fom 1934 to 1936 he was assigned to the development of propulsion control for submarines. He holds many patents on controllers and is the author of "Control of Electric Motors," published in 1936. Mr. Harwood is a member of the Association of Iron and Steel Engineers and of the United States Naval Institute.

H. E. Dexter (A'14, M'17) general commercial manager of the Central Hudson Gas and Electric Corporation, Poughkeepsie, N. Y., and chairman of the sales committee of the Edison Electric Institute, has been made a member of the executive committee of the National Adequate Wiring Bureau.

H. E. Thompson (A'26, M'30) has been transferred to the engineering headquarters of the Anaconda Wire and Cable Company at Hastings-on-Hudson, N. Y., from its Pawtucket, R. I., plant where he had been electrical engineer in charge of rubber development and research. Before becoming associated with Anaconda, Mr. Thompson was with the Brooklyn Edison Company.

J. T. Bartek (A'24, M'30) Seattle, Wash., has been made associate electrical engineer at the United States Navy Yard, Puget Sound, Bremerton, Wash. Mr. Bartek was with the Marconi Radio Corporation from 1915 to 1916; instructor in radio with the United States Army at Fort Winfield Scott, Calif., in 1917 and 1918; and draftsman on electrical design on various Stone and Webster engineering projects on the West Coast since 1919.

L. H. Erickson (A'35) has been made junior engineer with the United States Bureau of Reclamation, Denver, Colo. Mr. Erickson formerly was a draftsman for the State Highway Department of Colorado.

R. K. Hellman (A'37) has received second prize for his paper "An Audio Frequency Spectrometer," entered in a contest conducted by the Scientific Apparatus Makers of America. He is employed by Transatlantic Research and Information Service, Inc., New York, N. Y.

F. A. Muschenheim (A'98, M'01) has been elected a director of the Broadway Association, New York, N. Y. Mr. Muschenheim, a graduate of Stevens Institute, has been president of the Hotel Astor Corporation, New York, for nearly two decades.

W. S. Sharp (A'38) is now assistant engineer for the Jackson-Bayley Electric Company, Canton, Ohio. A graduate of the University of Kentucky in 1937, he formerly had been assistant research engineer with the Pulp Products Company of Massillon, Ohio.

G. J. Gross (A'30) has received a fifth prize for a paper entered in a contest conducted by the Scientific Apparatus Makers of America. He is assistant transmission engineer with the Pennsylvania Water and Power Company, Baltimore, Md.

J. B. Troja (A'32) is now in charge of sales of all General Electric Company's products in Lima, Peru, S. A. Mr. Troja was graduated from the University of Washington in 1930 and in that year entered the General Electric Company at Schenectady, N. Y. Lately he had been sales engineer in the International General Electric Company.

E. F. Pearson (M'20, F'37) has been appointed assistant to the president of the Northwestern Electric Company, Portland, Ore. He recently was appointed assistant to the president of Pacific Power and Light Company, an affiliated company, as announced in the June 1938 issue of Electrical Engineering.

N. H. Callard (A'16) has joined the staff of the vice-president and general sales manager of Westinghouse Electric and Manufacturing Company at Pittsburgh, Pa. Mr. Callard entered the employ of Westinghouse in 1912 and was, prior to his transfer to the East, central station manager of the San Francisco, Calif., office.

Ray Kernahan (A'36) has been made associate engineer of substation design at the Bonneville Project, Portland, Ore. Mr. Kernahan received the bachelor of science degree in electrical engineering from the State College of Washington in 1925 and had been electrical designer in the lighting department of the City of Seattle.

R. A. Beekman (A'13, M'27) has been appointed AIEE representative on the American Standards Association Sectional Committee on Electrical Installations on Shipboard—*C*66. Mr. Beekman is an engineer in the federal and marine department of the General Electric Company at Schenectady, N. Y.

F. A. Brown (A'32) has been made secretary-treasurer of Brown Brothers Lumber Company, Helena, Mont. A graduate of Montana State College in 1930, Mr. Brown was formerly assistant to the director of the north central division, Agricultural Adjustment Administration, United States Department of Commerce, Washington, D. C.

C. V. Armstrong (A'36) has become research assistant for the Iowa Engineering Experimental Station, Iowa State College, Ames. Mr. Armstrong was graduated from that university in 1935 and prior to his appointment was office engineer on condensers and centrifugal pumps for the Ingersoll-Rand Company, Chicago, Ill.

A. G. Dembrowski (A'38) has been made test engineer for the Hamilton Standard Propeller Company of East Hartford, Conn. Mr. Dembrowski received the degree of bachelor of science in engineering physics in 1937 and that of bachelor of science in electrical engineering in 1938 from the University of Michigan.

Franklin Clark (A'34) is now assistant electrical engineer for the Duro-Test Corporation of North Bergen, N. J. Mr. Clark was formerly with the Westinghouse Lamp Company at Bloomfield, N. J.

R. F. Tinnerholm (A'30) has been made manager of the switchgear sales division of the General Electric Company at Philadelphia, Pa. Prior to the recent change Mr. Tinnerholm had been section head of the switchgear department and has served the company in various capacities since 1907. He was in the air service of the United States Army during the World War.

H. W. Samson (A'24, M'30) has been appointed AIEE representative on the American Standards Association Sectional Committee on Drawing and Drafting Room Practice—*Z*14. Mr. Samson is engineer in charge of the data division of the General Electric Company, Schenectady, N. Y.

W. N. Zippler (A'20, M'38) has been appointed AIEE alternate representative on the American Standards Association Sectional Committee on Electrical Installations on Shipboard—*C*66. Mr. Zippler is an electrical engineer with Gibbs and Cox, Inc., New York, N. Y.

F. B. Hunt (A'37) has been made an electrical engineer in the distribution department of the Green Mountain Power Corporation at Burlington, Vt. Since his graduation from the University of Vermont in 1936, Mr. Hunt had been meterman with that company.

A. O. Lott (A'33) is now junior engineer with Porcelain Products, Inc., Parkersburg, W. Va. Mr. Lott was graduated from Georgia Institute of Technology in 1929.

Charles Wasserman (A'37) has received a fifth prize for a paper entered in a contest conducted by the Scientific Apparatus Makers of America. He is technical assistant with the Consolidated Gas, Electric Light and Power Company of Baltimore, Md.

S. G. Hibben (A'34) director of applied lighting of the lamp division of the Westinghouse Electric and Manufacturing Company (formerly Westinghouse Lamp Company), Bloomfield, N. J., has been appointed to the plan committee of the National Adequate Wiring Bureau.

R. G. Clay (A'38), a member of the 1938 class of the University of Illinois, is now draftsman for the Illinois Iowa Power Company, Champaign, Ill.

Obituary

André Eugène Blondel (A'05, HM'12) died November 15, 1938. Born at Chaumont, France, on August 28, 1863, he entered the École Polytechnique (class of 1883) after having been admitted to the École Normale Supérieure during the same year. Graduating from the École Nationale des Ponts et Chaussées in 1888, and given degrees in mathematics and physics in 1885 and 1889, he became an engineer in the Central Lighthouse Service, taking part in improvements made in the lighting service and planning the lenses and electrical machinery of many important lighthouses. In 1893 Professor Blondel was selected as the first occupant of the chair of applied electricity at École Nationale des Ponts et Chaussées, Paris; he continued his engagement with the lighthouse service until 1927, when he was inspector-general, and only recently retired to consulting work. He contributed many papers on electrical and optical subjects, and is credited with invention of the magnetic oscillograph, which he used in his study of alternating currents. In 1893 he explained mathematically the effect of inertia in the hunting of alternators; he also proposed the "two-reaction" theory of machines. A rational system of photometrical units proposed by him was adopted by the International Congress of Electricians at Geneva in 1896; other studies were carried on in arcs and wireless telegraphy. Professor Blondel was founder and president of the editorial staff of the publication *Revue générale de l'Électricité*. He was awarded prizes by the French Academy of Sciences in 1897 and 1898, and was a chevalier of the Legion of Honor, of which he was named commander in 1927. An honorary member of The Institution of Electrical Engineers, he was awarded that society's Faraday Medal in 1937. He was a past president of the Société française des Electriciens, and a member of numerous technical societies. Other honors he received included the Mascart Medal, the Gold Medal of the Franklin Institute, the Montefiore prize, and, in 1929, the triennial Lord Kelvin Medal.

Haywood Lewis Alderman (A'27, M'31) died on January 11, 1939, at Brooklyn, N. Y. He was born at Greensboro, N. C., August 14, 1883, and received his degree in electrical engineering from the North Carolina State College of Engineering in 1904. He spent six months in the test department of the Philadelphia Electric Company and two years in the test department of the General Electric Company, Schenectady, N. Y., before becoming operating engineer in 1906 with the Panama-American Corporation in Panama City. Following his return from Panama in 1909, Mr. Alderman spent ten years with Southern Power Company (now Duke Power Company), four years as a sales engineer, and three years with the Carolina Power and Light Company before going with Electric Bond and Share Company. Mr. Alderman had held various posts with that company, the last few years having been that of assistant engineer with Phoenix Engineering Corporation, New York, N. Y.

Llewellyn Willis Collings, Jr. (A'37) died at Detroit, Mich., on December 27, 1938. He was born at Riverton, N. J., on September 25, 1914, and received his degree in electrical engineering from Cornell University in 1936. He was a student engineer in the test department of the General Electric Company at Schenectady, N. Y., from the time of his graduation until he went with the Holley Carburetor Company in Detroit as engineer only a few months before his death. He was a member of Tau Beta Pi and Eta Kappa Nu.

Evan Parry (A'95), a partner in the firm of Preece, Cardew and Rider, London, England, died on December 17, 1938. Mr. Parry was born November 30, 1865, in North Wales. He received his degree of bachelor of engineering at Glasgow University in 1889. From that year until 1893 he was laboratory assistant to Lord Kelvin and then was appointed technical officer and engineering assistant with the City of London Electric Lighting Company. In 1895 he became assistant to H. F. Parshall, then consulting engineer in England to the General Electric Company. Other electrical engineering posts held by Mr. Parry before he became associated with the consulting engineering firm of Preece, Cardew and Rider were with the government at Wellington, New Zealand, and with the English Electric Company, Ltd., London.

Walter G. Whitmore (A'90), East Orange, N. J., died on November 30, 1938. He was born at Plymouth, Mass., and was graduated from Massachusetts Institute of Technology in 1887. That year he worked with Leonard and Izard and the next year with the Chicago Edison Company. In June 1889, he went with the Edison General Electric Company in New York, N. Y., as an engineer. He was made head of the engineering department for the New York district of the General Electric Company in 1893, manager of the order department in 1911, and commercial engineer in 1924, which position he held until his retirement in 1931.

Fritz Uhlenhaut, Jr. (A'89, M'94) for many years chief engineer for the Pittsburgh Railways Company and Duquesne Light Company of Pittsburgh, Pa., died on January 1, 1937, according to information but recently received. Mr. Uhlenhaut was about 80 years of age and during recent years had been living at Providence, R. I. He was a graduate of Stevens Institute of Technology, Hoboken, N. J., and, before going with the Pittsburgh Railways Company in the early part of the century, had held engineering positions with the Brooklyn Edison Company, the Field Engineering Company of New York, and the Philadelphia Traction Company.

George Henry Horne (A'10) electrical engineer at Glendale, Calif., died December 6, 1938. He was born May 13, 1885, at Nineveh, Pa., and was graduated from Western University of Pennsylvania (now Pittsburgh University) receiving the degree of electrical engineer in 1907. That year he went with Westinghouse Electric and Machine Company and the next year with the Pittsburgh Transformer Company. In 1911 he was electrical engineer with Mordenskjold and Fisher at Nampa, Idaho. The next year he went with the United States Reclamation Service, Los Angeles, Calif., where he remained for about five years. From 1920 through 1933 he was with the Western Precipitation Company, Los Angeles, and has been located at Glendale since that time.

Membership

Recommended for Transfer

The board of examiners, at its meeting on January 19, 1939, recommended the following members for transfer to the grade of membership indicated. Any objection to these transfers should be filed at once with the national secretary.

To Grade of Fellow

Hull, Blake D., chief engineer, Southwestern Bell Telephone Company, St. Louis, Mo.

1 to Grade of Fellow

To Grade of Member

Blenden, W. L., engineer, Southwestern Bell Telephone Company, St. Louis, Mo.
Bryant, E. P., chief operator, Boulder Power Plant, Boulder City, Nev.
Gillon, V. C., assistant to chief engineer, Oklahoma Gas and Electric Company, Oklahoma City, Okla.
Gilman, W. M., engineer, Jackson and Moreland, Boston, Mass.
Jones, R. A., engineer, General Electric Company, Buffalo, N. Y.
Kidder, A. H., assistant engineer of system planning, Philadelphia Electric Company, Philadelphia, Pa.
Nager, E. F., president, Nager Electric Co., Inc., Brooklyn, N. Y.
Tinling, H. B., engineer, Tinling and Powell, Inc., Spokane, Wash.
Wallis, John, system planning engineer, Oklahoma Gas and Electric Company, Oklahoma City.

9 to Grade of Member

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. If the applicant has applied for direct admission to a grade higher than Associate, the grade follows immediately after the name. Any member objecting to the election of any of these candidates should so inform the national secretary before February 28, 1939, or April 30, 1939, if the applicant resides outside of the United States or Canada:

United States and Canada

Adama, A. R., Des Moines Electric Company, Des Moines, Iowa.
Adams, C., Jr., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Allen, J. H., 2973 London Road, Oakland, Calif.
Allen, L. T., Allen Electric Company, Tulsa, Okla.
Allured, R. B., Cass City, Mich.
Arnold, W. O., Cooper Union, New York, N. Y.
Asbury, C. E., Illinois-Iowa Power Company, Bloomington, Ill.
Austin, H. G., Jr., 206 Sixth Avenue, Belton, Texas.
Bain, G. F., Copperweld Steel Company, New York, N. Y.
Baldwin, L. E. (Member), Memphis Light and Water Division, Memphis, Tenn.
Baugh, C., Stoll Oil Refining Company, Louisville, Ky.
Bejarano, J. R., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Birge, R. D., Jr., Louis Allis Company, Milwaukee, Wis.
Blodgett, P. C., Toltz, King, Day & Langford Electric Company, Houghton, Mich.
Bohrer, L. E., The Texas Pipe Line Company, Houston.
Bower, K. O., Commonwealth Edison Company, Chicago, Ill.
Boyd, W. E., Air Corps, United States Army, Randolph Field, Texas.
Brain, J. W., Black and Veatch, Consulting Engineers, Kansas City, Mo.
Brennecke, C. G., University of Toledo, Toledo, Ohio.
Bronski, C. R. (Member), Commonwealth Edison Company, Chicago, Ill.
Bunin, J., Department of Public Works of New York City, N. Y.
Burton, G. D., Idaho Power Company, Pocatello.
Buttler, G. H., Jr., Johnson and Johnson, New Brunswick, N. J.
Cannon, A. H., 703 Madison Street, Athens, Ala.
Carmichael, H. A., 50 Trowbridge Street, Cambridge, Mass.
Chu, L. J., 290 Massachusetts Avenue, Cambridge, Mass.
Clendineng, R. B., 14 Belvidere Street, Springfied, Mass.
Constantine, J. M., Constantine's Engineering Service, Newburgh, N. Y.
Cook, K. C., Bureau of Power and Light, Los Angeles, Calif.
Curtis, T. E., Tennessee Electric Power Company, Chattanooga.
Dash, C. C. (Member), Hertner Electric Company, Cleveland, Ohio.
Davenport, J. A. (Member), Corps of Engineers, United States Army, Cincinnati, Ohio.
DeCroce, G., Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.
Dejadon, H. H., Daniel Woodhead Company, New York, N. Y.
DeLancie, H. S., Maydwell and Hartzell, Inc., San Francisco, Calif.
DeWitt, D., Columbia University, New York, N. Y.
DuFresne, A. F., General Petroleum Corporation, Los Angeles, Calif.
Eckles, W. W. (Member), Gulf States Utilities Company, Beaumont, Texas.
Edwards, F. E., Jr., Firestone Tire and Rubber Company, Akron, Ohio.
English, L. L., Commonwealth Edison Company, Chicago, Ill.
Erichson, W. B., Jr., 7129 Mt. Vernon Street, Pittsburgh, Pa.
Erickson, D. H., Ellerbe and Company, St. Paul, Minn.
Erickson, W. H., Duquesne Light Company, McKeesport, Pa.
Ferber, A. L., General Motors Corporation, Grand Rapids, Mich.
Flowers, H. L., Proctor and Schwartz, Inc., Philadelphia, Pa.
Fowler, E. B., Northwestern Bell Telephone Company, Des Moines, Iowa.
Freed, J. H., Olson Construction Company, Lincoln, Nebr.
Gallup, E. E., RR 2, Wolcottville, Ind.
Ganther, C. E., Cleveland Electric Illuminating Company, Cleveland, Ohio.
Garrett, K. S., Philadelphia Electric Company, Philadelphia, Pa.
Gates, S. H., Southern Bell Telephone and Telegraph Company, Louisville, Ky.
Gedge, G. F., 2042 Bronx Street, New York, N. Y.
Gentry, R. D., Kansas Gas and Electric Company, Wichita.
Gentzel, P. M. (Member), Ohio Public Service Company, Elyria.
Gilbert, P. G., Westinghouse Electric and Manufacturing Company, Philadelphia, Pa.
Glenn, A. B., Automatic Winding Company, Harrison, N. J.
Glueckstein, H., Globe Union Manufacturing Company, Milwaukee, Wis.
Goetz, L. P., Nephi Fielding and Company, Shelley, Idaho.
Goodheart, C. F., Texas Agricultural and Mechanical College, College Station.
Goudy, P. R., Bailey Meter Company, Cleveland, Ohio.
Gowdey, M. V., United States Navy Department, Bremerton, Wash.
Graham, Q. (Member), Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Graugnard, J. B. C., Caire & Graugnard, Columbia Sugar Factory, Edgard, La.
Hadley, C. F., Magnolia Petroleum Company, Dallas, Texas.
Hall, J. I., Trumbull Electric Manufacturing Company, Plainville, Conn.
Hallaman, J. C., Texas Electric Service Company, Fort Worth.
Hanson, F. E. (Member), Western Electric Company, Kearny, N. J.
Hanville, S. H., Jr., Ashland Laboratory and Supply Company, Ashland, Ohio.
Hauss, F. E., Hauss and Company, Norwood, Ohio.
Hausz, W., 114 E. 32nd Street, New York, N. Y.
Hawley, K. F., Pennsylvania Water and Power Company, Baltimore, Md.
Hellmann, K., Empire Electric Company, Brooklyn, N. Y.
Herdman, C. T., 408 South Goodwin, Urbana, Ill.
Herman, G. L., Bradford Armature Works, East St. Louis, Ill.
Hess, E. F., Brooklyn Edison Company, Inc., Brooklyn, N. Y.
Hess, W. T. (Member), Louisiana Power and Light Company, New Orleans.
Hill, H. H., Halliburton Oil Well Cementing Company, Hebbronville, Texas.
Hodgson, G. T., University of Toronto, Toronto, Ont., Canada.
Hok, C. G. M., 500 Riverside Drive, New York, N. Y.
Hotchkiss, T. M. (Member), Southern California Edison Company, Ltd., Los Angeles, Calif.
Hoyt, T. C., Consolidated Edison Company of New York, Inc., New York, N. Y.
Huff, J. F., Southwestern Bell Telephone Company, Wichita, Kans.
Jacobson, C. R., Memphis Light and Water Division, Memphis, Tenn.
Jarchow, T. L., Northern States Power Company, Minneapolis, Minn.
Jewell, J. H. (Member), American Steel and Wire Company, Worcester, Mass.
Johnson, L. W., Harlowton, Mont.
Johnson, V. O., University of Missouri, Columbia.
Johnson, W. A., Central Illinois Light Company, Peoria.
Jones, I. (Member), Rural Electrification Project, Oklahoma City, Okla.

Kellogg, D. S., W. L. Maxson Corporation, New York, N. Y.
Keskinen, A. R., Erie Resistor Corporation, Erie, Pa.
Kimball, B. C., E. B. Badger and Sons, Boston, Mass.
Kingsley, W. H., Ideal Electric and Manufacturing Company, New York, N. Y.
Kirkman, O. C., Jr., Chattanooga Electric Power Board, Chattanooga, Tenn.
Kleemola, W. K., Vulcan Electric Company, Lynn, Mass.
Kolstad, C. K., International Business Machines Corporation, Brooklyn, N. Y.
Kramer, W. B., Duquesne Light Company, West Bridgewater, Pa.
Kreger, C. H. (Member), Public Service Company of Northern Illinois, Chicago.
Krook, P., 4039 11th N. E.. Seattle, Wash.
Krug, J. A. (Member), Tennessee Valley Authority, Knoxville.
Kuppinger, H. R., R. F. D. No. 4, Auburn, N. Y.
Kuretich, F. J., Colorado Fuel and Iron Corporation, Crested Butte, Colo.
Kurz, C. G., Jr., United States Government Printing Office, Washington, D. C.
Lacy, W. R., Board of Transportation, City of New York, New York, N. Y.
Lamphere, R., Westinghouse Electric and Manufacturing Company, Wilkinsburg, Pa.
Lang, W. Y., Bell Telephone Laboratories, Inc., New York, N. Y.
LaRoche, A. R., Electrical and Gas Association, New York, N. Y.
Leggio, J., Westinghouse X-Ray, Long Island City, N. Y.
Llewellyn, F. E., Gallatin E 12, Soldiers Field, Boston, Mass.
Loeffler, H. F., Wisconsin Telephone Company, Milwaukee.
Logerwell, F. L., Henningson Engineering Company, Inc., Omaha, Nebr.
Lusis, F. A., Boston Edison Company, Allston, Mass.
Malcolm, J. A., Jr., Jericho, Long Island, N. Y.
Masters, R. W., J. M. Rotz Engineering Company, Indianapolis, Ind.
Matthews, N. W., Rural Electrification Administration, Washington, D. C.
Matthews, R. W., W. N. Matthews Corporation, St. Louis, Mo.
Matthias, L. H., Allen Bradley Company, Milwaukee, Wis.
Mayhard, C. A., Indiana Steel Products Company, Valparaiso, Ind.
McCart, S. O., General Electric Company, Cleveland, Ohio.
McIntosh, C., Jr., Buffalo Niagara Electric Corporation, Niagara Falls, N. Y.
McLellan, J. A., Consolidated Edison Company of New York, Inc., New York, N. Y.
Milewski, C. A., Hart Manufacturing Company, Hartford, Conn.
Miller, C. E., Los Angeles Bureau of Power and Light, Boulder City, Nev.
Miller, N. C., Northern States Power Company, Minneapolis, Minn.
Miller, R. F., B. F. Goodrich Company, Akron, Ohio.
Mitchell, F. DuV., Shallcross Manufacturing Company, Collingdale, Pa.
Monson, C. F., Jr., Yakima Valley Junior College, Yakima, Wash.
Morgan, J. S., Allis-Chalmers Manufacturing Company, Knoxville, Tenn.
Morton, J. R., Memphis Light and Water Division, Memphis, Tenn.
Moser, R. C., Cincinnati Gas and Electric Company, Cincinnati, Ohio.
Murray, E. D. (Member), Chase Brass and Copper Company, Waterbury, Conn.
Nagel, F. D., General Electric Company, San Francisco, Calif.
Nagel, T. J., Columbia University, New York, N. Y.
Nelson, A. L., Indianapolis Broadcasting Incorporated, Indianapolis, Ind.
Nesbitt, A. D., New York Central Railroad, Cleveland, Ohio.
New, W. R., Tenneessee Valley Authority, Norris, Tenn.
Nolph, C. A., Union Pacific Coal Company, Rock Springs, Wyo.
Novak, K., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Oberdorf, R. C., Edison Light and Power Company, York, Pa.
Olsen, B., Jr., General Electric Company, Schenectady, N. Y.
Palmer, T. E., General Electric Company, Pittsfield, Mass.
Pann, S. G., Department of Water and Power, Los Angeles, Calif.
Parsons, J. E., Chesapeake and Potomac Telephone Company, Washington, D. C.
Pierce, J. R., Texas Electric Service Company, Fort Worth.
Pollock, R. C., Carolina Power and Light Company, Lumberton, N. C.
Pugh, P. S., American Gas and Electric Service Corporation, South Bend, Ind.
Reinhard, C. K., New York Telephone Company, New York, N. Y.
Richardson, H. C., Duquesne Light Company, Pittsburgh, Pa.
Rietow, L. A., Allis-Chalmers Manufacturing Company, Milwaukee, Wis.
Riggs, L. S., Samson Tire and Rubber Company, Los Angeles, Calif.
Robuck, J. B., Texas Power and Light Company, McKinney.
Rogers, R. N., Cleveland Electric Illuminating Company, Cleveland, Ohio.
Rose, F. H., Pacific Gas and Electric Company, Chico, Calif.
Rossi, O. L., Trumbull Electric Manufacturing Company, Plainville, Conn.
Ryder, H. S., General Electric Company, Schenectady, N. Y.
Rystrom, R. H., University of California, Riverside.
Safford, M. G., 28 Blodgett St., Springfield, Mass.
Sawyer, E. C., Gulf States Utilities Company, Beaumont, Texas.
Schenck, H. H., Tennessee Electric Power Company, Chattanooga.
Schlick, A. M., General Delivery, San Francisco, Calif.
Schwarz, F., Philadelphia Storage Battery Company, Philadelphia, Pa.
Sedgwick, R. P., Los Angeles Bureau of Power and Light, Boulder City, Nev.
Seppala, H. T., Canadian General Electric Company, Toronto, Ont., Canada.
Shaner, M. S., Southwestern Bell Telephone Company, St. Louis, Mo.
Sherer, C. M., Pennsylvania Water and Power Company, Holtwood.
Shinault, L. H., % Thomas H. Allen, Memphis, Tenn.
Shoemaker, D. K., Philadelphia Electric Company, Philadelphia, Pa.
Shook, W. R., Jr., Georgia School of Technology, Atlanta.
Short, H. D., Canada Wire and Cable Company, Leaside, Ont., Canada.
Siegfried, C. E., Bell Telephone Company of Pennsylvania, Pittsburgh.
Skog, J. H., 4305—15th Avenue N. E., Seattle, Wash.
Sloan, R. R., International Business Machines Corporation, Endicott, N. Y.
Small, R. M., Bowie Switch Company, San Francisco, Calif.
Stieber, T. E., Westinghouse Electric and Manufacturing Company, Philadelphia, Pa.
Strout, F. H., Northern Indiana Public Service Company, Hammond.
Strozier, C. C., Tennessee Eastern Electric Company, Johnson City.
Swenton, C. S., Consolidated Edison Company of New York, Inc., New York, N. Y.
Tanchel, M., Mandell Institute, New York, N. Y.
Taverner, H. B. (Member), Commonwealth Edison Company, Chicago, Ill.
Thiel, E. A., Swift and Company, Chicago, Ill.
Thiesfeld, H., Rural Electrification Administration, Washington, D. C.
Tomberg, S., Tomberg Electric Supply Company, Wilkes-Barre, Pa.
Treuhaft, M., % J. C. Batchelor, Consulting Engineer, New York, N. Y.
Troche, H., Soil Conservation Service, Sheridan, Wyo.
Turner, R. E. (Member), Susquehanna Electric Company, Conowingo, Md.
Uptegraff, R. E., Jr., R. E. Uptegraff Manufacturing Company, Pittsburgh, Pa.
Vincens, E. (Member), Tennessee Valley Authority, Knoxville.
von Brecht, C. H., Southeast Missouri Telephone Company, St. Louis.
Vreeland, W. G. E., Consolidated Edison Company of New York, Inc., New York, N. Y.
Wagner, R., Jr., New York Telephone Company, Brooklyn, N. Y.
Wall, H. R., Tennessee Electric Power Company, Chattanooga.
Warman, W. C., Chesapeake and Potomac Telephone Company, Washington, D. C.
Warskow, M. A., W. K. Kellogg Company, Battle Creek, Mich.
Watson, J. P., Tennessee Valley Authority, Guntersville Dam, Ala.
Waugh, C. L., United States Department of Interior, Bonneville Project, Portland, Ore.
West, B. C., CCC Company 4607, Camp Dubois DG-98, Dubois, Idaho.
White, H. P., The Chesapeake and Potomac Telephone Company of Virginia, Richmond.
White, W. S., Bell Telephone Company of Pennsylvania, Philadelphia.
Widener, B. M., Virginia Polytechnic Institute, Blacksburg.
Williams, N. A., International Nickel Company, Ltd., Copper Cliff, Ont., Canada.
Willis, J. M., City of Florence, Florence, Ala.
Wright, R. L., Anaconda Wire and Cable Company, Pawtucket, R. I.
Young, C. L., West Texas Utilities Company, Abilene.

Total, United States and Canada—203

Elsewhere

Askew, W. B., Borough of Watford, Electricity Department, Watford, England.
Egan, D. G., % R. L. Suggs, Humble Oil and Refining Company, Netherlands Indies.
Jaggia, S. S., % Midland Bank Ltd., Stafford, England.
Jain, R. S. (Member), Benares Hindu University, Benares, India.
Krishnaswamy, S., Mysore Electrical Department, Bangalore, India.
Smith, M. S. S. (Member), Hawera Hospital Board, Hawera, New Zealand.

Total elsewhere—6

Engineering Literature

New Books in the Societies Library

Among the new books received at the Engineering Societies Library, New York, recently are the following which have been selected because of their possible interest to the electrical engineer. Unless otherwise specified, books listed have been presented gratis by the publishers. The Institute assumes no responsibility for statements made in the following outlines, information for which is taken from the preface of the book in question

ELECTRICAL MACHINERY, a Practical Study Course on Installation, Operation. and Maintenance. By F. A. Annett. Second edition. New York and London, McGraw-Hill Book Company, 1938. 429 pages, illustrated, 9 by 6 inches, cloth, $3.00. This book aims to provide a course of home study for electricians, power-plant men, and others who work with electrical machinery. Theory and practical applications are explained in clear, simple language, beginning with the fundamentals of electricity and continuing through the usual equipment. This new edition has been considerably enlarged and thoroughly modernized.

PRINCIPLES of ELECTRICITY and ELECTROMAGNETISM. By G. P. Harnwell. New York and London, McGraw-Hill Book Company, 1938. 619 pages, illustrated, 9 by 6 inches, cloth, $5.00. A textbook covering, in addition to the basic laws and general concepts, such subjects as dielectrics, thermionic vacuum tubes and their circuits, chemical, thermal and photoelectric effects, and radiation. The emphasis is on the experimental and scientific rather than on the mathematical or engineering aspects of the subject. Vector notation is used and a unification is achieved by the consistent use of absolute practical units and the electromagnetic approach to magnetism.

ELEKTROTECHNIK, Einführung in die Starkstromtechnik. Vol. 2. Die Gleichstromtechnik. (Sammlung Göschen 197). By I. Herrmann. Sixth edition. Berlin, Walter de Gruyter & Company, 1938. 144 pages, illustrated, 6 by 4 inches, cloth, 1.62 rm. An elementary text on d-c work, presenting the theory of d-c generators and motors, describing the construction and operation of d-c machines, and covering the general subject of transformers, rectifiers and lead, and alkali storage batteries.

GRUNDLAGEN der ATOMPHYSIK. By H. A. Bauer. Vienna, Julius Springer, 1938. 249 pages, illustrated, 8 by 5 inches, paper, 12.60 rm. A discussion of the development and present status of atomic physics, considered under the three main headings: Particle structure of matter; wave structure of matter; and the combination wave-corpuscular theory.

HISTORY of RADIO to 1926. By G. L. Archer. New York, American Historical Society, 1938. 421 pages, illustrated, 10 by 6 inches, cloth, $4.00. A survey of the development of radio from the earliest attempts at communication of signals to the status of the industry in 1926. Concerned mainly with persons, events and organizations; nevertheless the fundamental discoveries and experiments leading up to the practical use of the art are treated.

MacRAE'S BLUE BOOK and Hendrick's Commercial Register. 46th Annual Edition, 1938–39. New York and Chicago, MacRae's Blue Book Company, 1938. 3,604 pages, illustrated, 11 by 8 inches, cloth, $15.00. Provides an index of manufacturers and wholesalers and their local distributors, with addresses; an indexed classified list of manufacturers; a directory of commercial bodies, banks, railroads and warehouses in towns of one thousand or more population; and a list of trade names.

RIGHT WAGES and ABUNDANCE. By A. G. McGregor. New York, E. P. Dutton and Company, 1938. 316 pages, 8 by 6 inches, cloth, $2.50. Discusses production and consumption capacities, wages and prices, with particular reference to their interrelation. The economic policies of Great Britain and the United States since the World War are examined, and the adjusting of bank credits, exchange policies, and trade factors for the establishment of international amity are considered.

METAL COLORING and FINISHING. (Authorized translation from the second revised edition.) By H. Krause. New York, Chemical Publishing Company, 1938. 222 pages, tables, 9 by 6 inches, cloth, $5.00. Metal coloring and finishing by chemical, mechanical and electrical processes are discussed from theoretical and practical points of view, with references to patents.

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☐ 37-866	Appleman	*The Cause and Elimination of Noise in Small Motors
☐ 38-53	Calvert	†Amplitudes of the MMF Harmonics for Fractional Slot Windings
☐ 38-54	Porter	*Positive-Grid Characteristics of Triodes
☐ 38-55	Bewley	*Traveling Waves Initiated by Switching
☐ 38-56	Subcommittee Report	*Line-Type Lightning-Arrester Performance Data
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Papers Presented at Pacific Coast Convention, Portland, Ore., August 9–12, 1938

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☐ 38-43	Lightning Arrester Subcom.	*Testing and Application of Lightning Arresters
☐ 38-99	Monroe	†Electrification of the San Francisco-Oakland Bay Bridge Railway
☐ 38-100	Whelchel	*Trends in Electrical Equipment in Hydraulic Power Plants
☐ 38-101	McMillan	*Polarity Limits of the Sphere Gap
☐ 38-102	Smith	*Use of Bismuth Bridge Magnetic Fluxmeter for A-C Fields
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☐ 38-118	Pierce and Hamilton	Phase-Angle Control of System Interconnections
☐ 38-119	Lyon	The Electrostatic Unbalance of Transmission Lines

Papers Presented at Southern District Meeting, Miami, Fla., November 28–30, 1938

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☐ 38-121	Kuhn	Electrolysis and Corrosion of Underground Metallic Structures
☐ 38-123	Evans	Lightning Protection Improvements for Transmission Lines
☐ 38-124	Kirkwood	Grading the Engineer's Job
☐ 38-125	Almond	Electrical Design of Pickwick Landing Project
☐ 38-126	Jones	Mulsifyre System for Extinguishing Oil Fires
☐ 38-127	Housley	Reconditioning of Insulating Oils by Activated Alumina
☐ 38-128	Stratton & Stratton	Shop Practice in the Repair of High-Voltage Bushings
☐ 38-129	George & Bessesen	Generator Damper Windings at Wilson Dam

* These papers have been published in the TRANSACTIONS section of ELECTRICAL ENGINEERING.
† These papers have been published in the 1938 AIEE Transactions volume.